

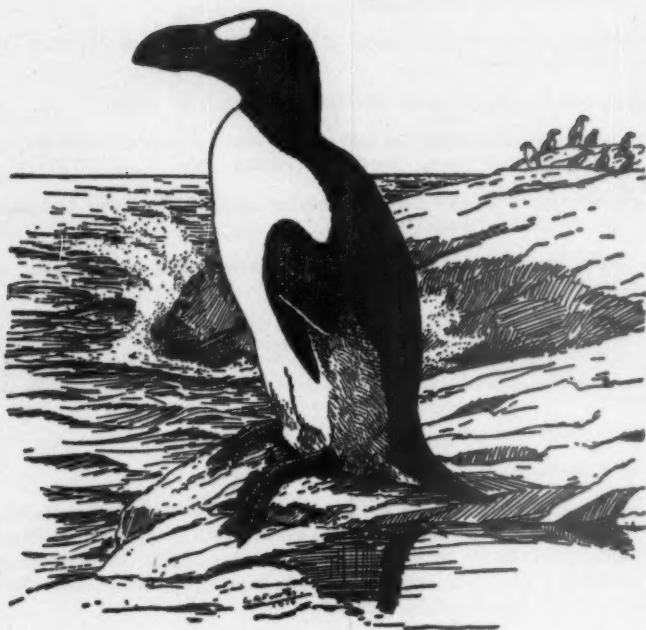
# The Auk

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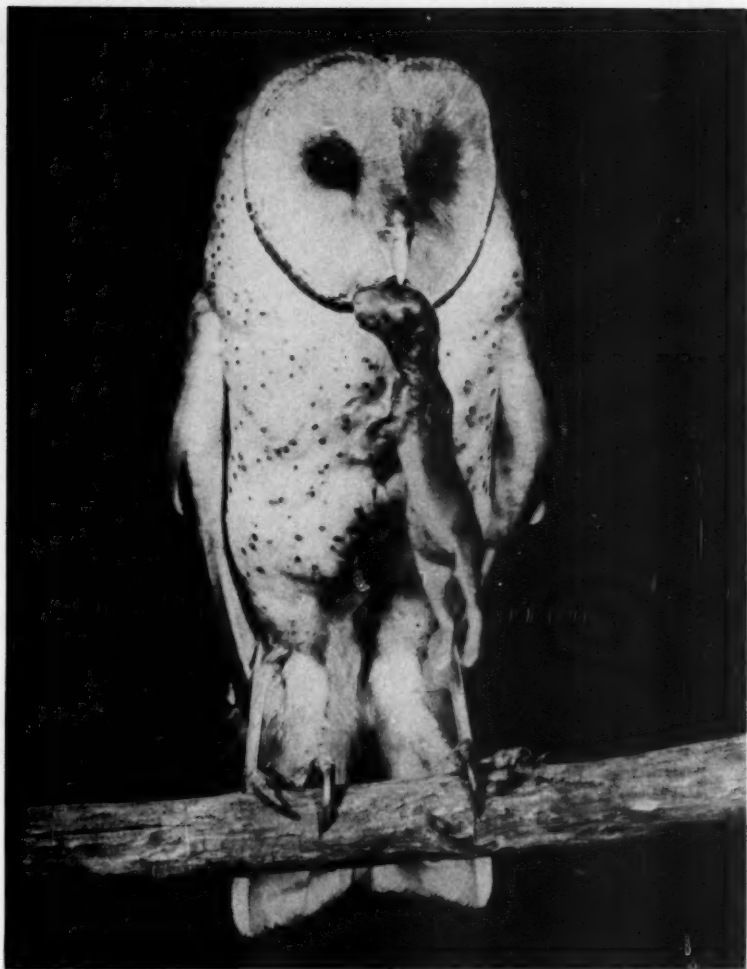
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Photograph by Karl H. Maslowski

BARN OWL, *Tyto alba pratincola*, BRINGING YOUNG COTTONTAIL RABBIT TO ITS NEST. DURING THE PERIOD OF MAY TO AUGUST, 1947, I SPENT AN ESTIMATED THREE TO TEN HOURS PER NIGHT OBSERVING BARN OWLS AT THEIR NESTS ALONG THE LITTLE MIAMI RIVER NEAR CINCINNATI, OHIO. THEIR PREY CONSISTED ALMOST ENTIRELY OF RATS AND MICE, BUT ON THREE OCCASIONS VERY YOUNG RABBITS WERE BROUGHT TO ONE PARTICULAR NEST. JUDGING BY THE RABBIT FUR ON THE OWL'S TALONS I ASSUME THE RABBIT WAS TAKEN DIRECTLY FROM THE NEST. BUT HOW DID THE OWL FIND THE RABBIT; BY SEEING THE FUR LINING OF THE NEST MOVE, OR BY WATCHING THE MOTHER RABBIT? WOULD THE BONES OF SO YOUNG A RABBIT BE SUFFICIENTLY OSSIFIED TO BE FOUND IN THE PELLETS OF YOUNG OWLS?—Karl H. Maslowski, Cincinnati, Ohio.



# THE AUK

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### ANALYSIS OF UNUSUAL BIRD MIGRATION IN NORTH AMERICA DURING THE STORM OF APRIL 4-7, 1947

BY W. W. H. GUNN AND A. M. CROCKER

#### INTRODUCTION

THE occurrence of a phenomenally early wave of insectivorous migrant birds at Toledo, Ohio, on April 5 and 6, 1947, was reported by Mayfield (1947). He suggested that there might be a meteorological explanation for this event, for "on April 5 an intense low-pressure area developed in Kansas and moved northeastward, marked by tornadoes in Oklahoma and Missouri and accompanied by strong south winds in the eastern Mississippi Valley and Lake region."

Baillie (1947) and Saunders (1947) recorded the equally unusual wave of migrants which was noted at Toronto, Ontario, on April 5, 6, and 7, 1947, virtually simultaneously with the one at Toledo. Similar reports from observers in extreme southern Ontario made it evident that the two waves were really part of the same phenomenon.

While there are numerous instances of birds in North America being transported far off-course by maritime and oceanic storms, this has not been the case for continental disturbances. The authors of the present paper, therefore, felt that it would be of value to bring together published and unpublished records pertinent to this particular occurrence and to analyse them in relation to the meteorological conditions prevailing over the continent at that time.

The difficulty with such an analysis lies in the scattered and fragmentary nature of the data on birds. If more were known about bird distribution and movements during migration, the correlation with weather data would probably be much more evident. Such factors as irregularity in time and duration of observation-periods, the attendant emphasis on week-ends, and the lack of a central clearing-house for the detailed information collected make it impossible to reduce the data on birds to figures that may be compared quantitatively with those obtained by the network of weather stations.

However, within these limitations, it is believed that the accumulated information does present an interesting picture, even though many blank spaces remain in it. It is hoped that this paper may be the means of bringing to light some of the information necessary to fill these blanks.

*Acknowledgments.*—This study was made possible only because a great many ornithologists were kind enough to locate and compile for their particular region the records which had to be assembled in order to provide a composite, over-all picture for analysis.

Persons who contributed such information or gave assistance in tracing it to its source are: Mr. Emmet R. Blake of Chicago Natural History Museum; Dr. Donald J. Borror of Ohio State University; Professor Maurice Brooks of West Virginia University; Mr. Louis W. Campbell of Toledo, Ohio; Mr. Ben B. Coffey, Jr., of Memphis, Tenn.; Mr. Philip A. DuMont of the Fish and Wildlife Service, Washington D. C.; Mr. William Girling of London, Ont.; Mr. Ludlow Griscom of Museum of Comparative Zoology, Cambridge, Mass.; Mr. James W. Hancock of Madisonville, Ky.; Dr. Lee Roy Herndon of Elizabethton, Tenn.; Dr. Joseph C. Howell of University of Tennessee; Mr. Monroe Landon of Simcoe, Ont.; Dr. Harvey B. Lovell of University of Louisville; Dr. George H. Lowery, Jr., of Louisiana State University; Mr. Harold Mayfield of Toledo, Ohio; Mrs. D. S. Miller of Detroit, Mich.; Mr. Harold D. Mitchell of Buffalo, N. Y.; Messrs. Burt Monroe, Sr. and Jr., of Louisville, Ky.; Mrs. Robert A. Monroe of Knoxville, Tenn.; Mr. George W. North of University of Toronto; Mr. Henry M. Parker of Cambridge, Mass.; Mr. Chandler S. Robbins of Fish and Wildlife Service, Laurel, Md.; Dr. R. M. Saunders of University of Toronto; Mrs. E. R. Smith of Two Rivers, Wisc.; Mr. Jerry Stillwell of Dallas, Tex.; Mr. Arthur Stupka, Park Naturalist at Great Smoky Mountain National Park, Tenn.; Mr. Milton B. Trautman of Stone Laboratory, Put-in-Bay, Ohio; Mr. M. G. Vaiden of Rosedale, Miss.; Mr. Francis M. Weston of Pensacola, Fla.; Professor George G. Williams of Rice Institute, Houston, Tex.; Mr. Gordon Wilson of Western Kentucky State Teachers College, Ky.; Mrs. T. E. Winford of Dallas, Tex.; and Mr. A. A. Wood of Chatham, Ont.

The authors are particularly indebted to Mr. James L. Baillie, Research Assistant of the Royal Ontario Museum of Zoology; Mr. Baillie made a starting point for this study by compiling the pertinent records from Toronto and southern Ontario. He provided data from his journals covering arrival dates in the Toronto region for the past 27 years and gave enthusiastic assistance throughout the preparation of the manuscript.

Helpful criticism of the manuscript was kindly offered by Mr. Aaron M. Bagg of Holyoke, Mass., and by Mr. L. L. Snyder, Curator of Ornithology, Royal Ontario Museum of Zoology.

Thanks are due to Mr. Andrew Thomson, Controller of the Meteorological Division of the Department of Transport (Canada) for permission to consult the official meteorological records and the original synoptic charts in the preparation of Figures 1 to 4. These figures were prepared by Mr. Eric Thorn of the Royal Ontario Museum of Zoology.

#### RECORDS FROM SOUTHERN ONTARIO

At Toronto, local manifestations of the cyclonic disturbance were rain and fog on April 5 and, on April 6, a strong southwest wind

accompanied by a rise in temperature. Even before the windstorm had subsided, observers at Toronto began to report the occurrence of migrant birds which may be grouped into two classes: 1) species appearing regularly in this region each spring, but in this instance reported many days before their previous earliest recorded arrival date; 2) species considered rare in the region at any time.

As reports from various parts of southern Ontario were accumulated, the coincidence of irregular occurrences became known and it was recognized that something of an unusual nature had occurred to displace so many individuals and species in both time and space.

Table 1 is a compilation of rare and/or early migrants reported from southern Ontario for the period April 1-25, 1947. For birds observed later than, say, April 9, it may be supposed that: a) they reached the region during the period of the storm, but remained unnoticed until the date on which they were reported; or b) they were carried beyond their normal route-pattern by the storm, but did not reach southern Ontario until they made a further advance, perhaps during periods favorable to northward migration such as occurred on April 10-11 and April 17; or c) their appearance in the region was unrelated to the storm of April 4-7.

Some comment should be made in regard to the following species mentioned in Table 1:

WHITE-EYED VIREO, *Vireo griseus*.—An individual was found dead at Westboro, a suburb of Ottawa, on April 7. It appears to have been farther off course than any other and constitutes a remarkable record. Mowat (1947) and Lewis (1948) list a total of seven previous records in Ontario, so that this would seem to be the eighth. However, the previous records were either from the Toronto region or the Lake Erie region of extreme southern Ontario.

RED-EYED VIREO, *Vireo olivaceus*.—The Red-eyed Vireo from Meaford (Georgian Bay region of Lake Huron) and the above-mentioned White-eyed Vireo together constitute the two most northern records in the table. It is of interest to note that both were found dead.

HOODED WARBLER, *Wilsonia citrina*.—Six individuals are listed for various areas in the Toronto region. An additional five, not listed, were seen in the Toronto region between April 26 and May 3. While some of these may represent duplications, it is nevertheless probable that more were present during April and early May than had been reported previously at Toronto for all seasons and for all the time that local records have been kept.

SUMMER TANAGER, *Piranga rubra*.—The individual discovered by Mr. F. H. Emery in the vicinity of his home at Toronto remained

TABLE 1  
UNUSUAL OBSERVATIONS REPORTED FROM SOUTHERN ONTARIO DURING APRIL 1-25, 1947

April	Species	Locality	County	Observers	Significance of record
1-4	None	Toronto	York	Waters	Abnormally early
5	Blue-headed Vireo	Toronto	York	Lambert	Abnormally early
6	Nighthawk	Toronto	York	North	Abnormally early
6	Chimney Swift	Turkey Point	Norfolk	Stark	Abnormally early
6	Wood Pewee	Toronto	York	Baillie <i>et al.</i>	Abnormally early
6	Parula Warbler	Toronto	York	Douglas, Allworth	Abnormally early
6	Blackburnian Warbler	Toronto	York	Parkinson	Abnormally early
6	Hooded Warbler	Port Dover	Norfolk	Field, Dwight	Exceptionally rare
6	Hooded Warbler, male	Toronto (Strathgowan)	York	Cook, Gunn	Exceptionally rare
7	Chimney Swift	Toronto	York	Cook, Gunn	Abnormally early
7	Least Flycatcher	Toronto	York	Cook, Gunn	Abnormally early
7	White-eyed Vireo (dead)	Westboro	Carleton	Valois	Entirely extralimital
7	Red-eyed Vireo	Toronto	York	Waters	Abnormally early
8	Catbird	Ancaster	Wentworth	Halladay	Abnormally early
9	Red-eyed Vireo (dead)	Meaford	Grey	Beamer	Abnormally early
9	Hooded Warbler, male	Toronto (Baby Point)	York	Gough	Exceptionally rare
9	Hooded Warbler, female (dead)	Toronto (Runnymede)	York	Mrs. Sines	Exceptionally rare
10	Blue-gray Gnatcatcher	Cedar Springs	Kent	Stirrett	Abnormally early
11	Black and White Warbler	Toronto (Sherwood Park)	York	Miss Hambleton	Abnormally early
11	Black and White Warbler	Toronto (Grenadier Pond)	York	Shortt	Abnormally early
12	Oven-bird	Toronto	York	Sherrin	Abnormally early
13	Blue-gray Gnatcatcher	Point Pelee	Essex	Lancaster	Abnormally early
13	Hooded Warbler, male	Toronto (Glencairn Ave.)	York	MacArthur	Exceptionally rare
13	Summer Tanager, male	Toronto (Beech Ave.)	York	Bodsworth	Entirely extralimital
13	Harris's Sparrow	Toronto	York	Lansa	Entirely extralimital
17	Blue-gray Gnatcatcher, male	Toronto (Old Mill Terr.)	York	Cook, Gunn	Exceptionally rare
18	Summer Tanager, male	Port Hope	York	Emery	Entirely extralimital
18	American Redstart	Hamilton	Durham	Ness	Abnormally early
19	Blue-gray Gnatcatcher	Toronto	Wentworth	North	Exceptionally rare
19	American Redstart	Toronto	York	Halladay, Helleiner	Abnormally early
20	Yellow-throated Vireo	Toronto	York	Miss Lawrence	Abnormally early
24	Worm-eating Warbler	Toronto	York	Scovell, Swift	Entirely extralimital
24	Hooded Warbler, male	Toronto (High Park)	York	Scovell	Exceptionally rare
24	Hooded Warbler, male	Toronto (High Park)	York	W. Martin	Exceptionally rare

there long enough to afford a great many people their first opportunity to observe this species. It was a male which had not yet attained its full breeding plumage, having green wings and a green band on the head. Only four previous records are known for Toronto.

WORM-EATING WARBLER, *Helmitheros vermivorus*, and HARRIS SPARROW, *Zonotrichia querula*.—There are no specimens for the Toronto region, but there have been a few previous sight records for these two species.

With the exception of the Harris's Sparrow, which migrates northward west of southern Ontario, species indicated as being rare or extralimital in Table 1 invariably have their center of abundance south and/or southwest of southern Ontario.

#### COMPARISON OF ARRIVAL DATES FOR THE TORONTO REGION

Table 2 is designed to illustrate the wide disparity in time between the first dates for species included in Table 1 as observed at Toronto and the earliest and mean arrival dates for the same species in the same region in previous years. The dates for previous years are compiled from observations made by one observer only (Baillie), but they cover a period of 27 years of active observation in the field and it is believed that they present an accurate picture for the Toronto region.

TABLE 2

ARRIVAL DATES IN 1947 FOR 17 SPECIES IN THE TORONTO REGION, COMPARED WITH EARLIEST AND MEAN ARRIVAL DATES RECORDED BY MR. JAMES L. BAILLIE IN THE TORONTO REGION DURING THE PERIOD 1920-1946, INCLUSIVE

Species	Number years recorded, 1920-1946	Earliest arrival date	Mean arrival date	Earliest date in 1947	Number days in advance of:	
					Earliest date	Mean date
Nighthawk	27	May 5	May 14	April 6	29	38
Chimney Swift	27	April 28	May 9	April 7	21	32
Least Flycatcher	26	April 28	May 10	April 7	21	33
Wood Pewee	26	May 13	May 21	April 6	37	45
Blue-gray Gnatcatcher	3	April 22	May 5	April 17	6	18
Yellow-throated Vireo	12	May 13	May 23	April 20	23	33
Blue-headed Vireo	20	May 1	May 9	April 5	26	34
Red-eyed Vireo	25	May 12	May 16	April 7	35	39
Black and White Warbler	26	April 26	May 4	April 11	15	23
Worm-eating Warbler	0	—	—	April 23	—	—
Parula Warbler	21	May 6	May 13	April 6	30	37
Blackburnian Warbler	26	May 2	May 12	April 6	26	36
Oven-bird	26	May 3	May 10	April 12	21	28
Hooded Warbler	0	—	—	April 6	—	—
American Redstart	26	May 2	May 11	April 19	13	22
Summer Tanager	0	—	—	April 13	—	—
Harris's Sparrow	0	—	—	April 13	—	—
Mean number of days (13 species)					23	32



An indication of the regularity with which a species occurs at Toronto is given in column 2 which shows, out of a possible 27, the number of years in which Baillie observed the species in the Toronto region.

Calculations derived from columns 6 and 7 show that the 13 species listed therein were, on the average, 23 days earlier than Baillie's earliest arrival dates and 32 days earlier than his mean arrival dates.

#### RECORDS FROM EASTERN UNITED STATES

In the light of the observations from Toledo (Mayfield) and southern Ontario (Table 1), certain records among those mentioned by DuMont (1947) for the Chicago region, Black and Wallace (1947) for the Detroit region, and Beardslee (1947) for the Buffalo region assume particular importance.

In order to supplement the data available from the literature, the authors wrote to ornithologists in a number of sections of the eastern United States. By the use of information provided through the kindness and co-operation of these contributors, it has been possible to augment the data for Table 3. This table is, therefore, a compilation of unpublished reports and published records. It presents spring arrival dates, where available, for 31 species from 24 localities, ranging from the Gulf of Mexico to the Great Lakes. While it provides a fairly good coverage of the whole area, there are still large gaps in important regions such as, for example, western Pennsylvania, Indiana, Missouri, Arkansas, Alabama, and Georgia.

It was hoped that such a table might bring out some or all of the following information: 1) the scope and incidence of the early wave(s) of April 3-7, 1947; 2) dates on which those of the species which migrate from Central or South America first reached North America; and 3) some clues as to the probable starting point of the flight which ended at the Great Lakes on April 5-7. While the table leaves some of these questions unanswered, it does provide, in summarized form, a good deal of information about the problem.

Along the Great Lakes, unusual occurrences were first reported on April 5 and were numerous from April 6 through April 8. The largest number of such occurrences was reported from urban or suburban areas where the density of human observers was greatest, but there was a striking difference in that far more were reported from Toledo and Toronto than from Detroit and Buffalo. In rural areas where human observers were fewer, these occurrences were reported chiefly from the north shore of Lake Erie, on or close to a line representing the shortest distance between Toledo and Toronto.

TABLE 3  
RECORDS OF SPRING ARRIVAL IN 1947 FROM 24 LOCALITIES RANGING FROM THE GREAT LAKES AND NEW  
ENGLAND TO THE GULF OF MEXICO. OCCURRENCES WITHIN THE SEVEN-DAY PERIOD APRIL  
3-9 ARE SHOWN IN BOLDFACE TYPE; THOSE EARLIER THAN APRIL 3 ARE ITALICIZED

Species	Northern Illinois	Southern Michigan	Toledo, Ohio	Southern Ontario except Toronto	Toronto, Ontario	Buffalo, New York	Central Ohio	Wheeling, W. Va.
Whip-poor-will.....	April 20	May 1	April 6	April 19	April 26	April 12	May 17	
Nighthawk.....		May 10	May 17	May 13	April 6	May 19	May 4	
Chimney Swift.....	April 10	April 24	April 6	April 6	April 7	April 30	April 6	
Least Flycatcher.....		May 14	April 26	May 2	April 7	April 26	May 4	
Wood Pewee.....		May 14	May 13	May 12	April 6	May 14	May 14	
Cliff Swallow.....		April 24	May 18	May 13	?	May 1		
Catbird.....	April 27	April 29	April 23	April 10	May 4	April 7	April 24	
Blue-gray Gnatcatcher.....	April 30	April 26	April 6	April 7	April 17	April 7	April 6	
White-eyed Vireo.....	April 17		April 27	April 7		April 7	April 27	
Yellow-throated Vireo.....		May 3	April 6	May 11	April 20	May 2	May 3	
Blue-headed Vireo.....		May 14	May 1	May 2	April 5	April 28	May 10	
Red-eyed Vireo.....		May 1	April 5	April 9	April 7	May 4	May 3	
Black and White Warbler.....		April 8	April 6	April 30	April 11	April 26	April 5	
Prothonotary Warbler.....	April 7	May 5	April 6	?		May 10	April 6	
Worm-eating Warbler.....			April 26	May 15	April 24	May 11	May 10	
Golden-winged Warbler.....		May 10	April 26	May 3	April 6	May 2	May 14	
Parula Warbler.....		May 13	May 2	May 12	April 14	May 2	May 10	
Magnolia Warbler.....		May 2	April 29	May 3	May 4	May 2	May 10	
Black-throated Green Warbler.....		April 26	April 27	May 2	May 3	April 26	May 14	
Blackburnian Warbler.....		April 6	May 3	April 24	April 6	April 16	April 26	
Palm Warbler.....		April 6	April 26	April 26	May 1	April 30	April 26	
Oven-bird.....	April 26	April 19	May 4	May 2	April 12	May 3	April 30	
Northern Water-thrush.....	April 29	May 11	April 6	April 27	May 1	April 30		
Louisiana Water-thrush.....	April 17	May 11	April 6	May 4		May 3	April 10	April 6
Kentucky Warbler.....	April 30	May 11	May 3	May 4		May 3	May 10	
Yellow-throat.....		April 29	April 29	May 3	May 3	May 2	April 20	April 6
Hooded Warbler.....		April 6	April 6	April 6	April 6	April 6	May 10	April 6
American Redstart.....	April 30	May 10	April 29	May 13	April 18	May 2	May 14	
Orchard Oriole.....		May 18	?	May 13		April 30	May 10	
Scarlet Tanager.....		April 6	May 11	May 12	May 15	May 12	May 10	
Summer Tanager.....					April 13		May 10	

TABLE 3—(Continued)

Species	Morgan- town, W. Va.	Charles- ton, W. Va.	Washing- ton, D. C.	Massa- chusetts	Louis- ville, Kentucky	Bowling Green, Kentucky	Madison- ville, Kentucky	Memphis, Tenn.
Whip-poor-will.....			April 6	April 19	April 6	April 27	—	—
Nighthawk.....			May 8	April 30	May 8	April 24	April 30	April 23
Chimney Swift.....			April 6	April 12	March 31	April 3	April 3	March 30
Least Flycatcher.....			May 6	April 29	May 4	—	May 5	—
Wood Pewee.....			April 27	May 3	May 4	April 25	April 27	—
Cliff Swallow.....			April 17	April 7	May 5	April 22	—	—
Catbird.....			April 20	April 25	April 25	April 6	April 20	April 20
Blue-gray Gnatcatcher.....			April 12	April 9	April 4	April 6	April 6	March 30
White-eyed Vireo.....			April 19	—	April 23	April 20	April 9	April 10
Yellow-throated Vireo.....			April 20	May 7	May 2	April 26	April 20	April 7
Blue-headed Vireo.....			April 27	April 11	—	April 26	—	—
Red-eyed Vireo.....			April 10	April 22	April 6	March 13	April 14	April 7
Black and White Warbler.....	April 3	April 4	—	—	—	—	—	March 30
Prothonotary Warbler.....			April 27	May 14	May 3	April 26	—	—
Worm-eating Warbler.....			April 30	May 7	May 5	May 11	May 5	April 12
Golden-winged Warbler.....	April 5		April 12	April 24	May 3	May 10	May 8	April 13
Parula Warbler.....		April 5	May 3	May 8	May 9	May 11	May 16	May 2
Magnolia Warbler.....			April 24	April 29	April 6	April 24	April 24	April 16
Black-throated Green Warbler.....	April 3	April 5	April 30	April 29	May 3	May 3	April 28	April 12
Blackburnian Warbler.....			March 29	April 10	May 3	—	April 21	April 19
Palm Warbler.....			April 19	May 2	May 3	April 27	—	April 7
Oven-bird.....			April 13	April 29	May 5	May 5	May 2	April 13
Northern Water-thrush.....			April 6	April 10	April 6	April 13	—	April 13
Louisiana Water-thrush.....		April 6	April 30	May 15	April 30	April 27	April 20	April 12
Kentucky Warbler.....			April 19	April 30	April 26	April 20	April 11	April 13
Yellow-throat.....		April 4	April 13	May 7	May 3	April 13	April 7	April 6
Hooded Warbler.....		April 6	April 12	April 30	May 3	April 13	May 4	April 15
American Redstart.....	April 4		April 7	—	—	April 26	April 25	April 23
Orchard Oriole.....			May 14	May 7	April 22	April 26	April 23	April 15
Scarlet Tanager.....			—	—	—	—	—	—
Summer Tanager.....			May 14	May 7	April 24	April 26	April 23	April 15



TABLE 3—(Continued)

Species	Knoxville, Tenn.	Great Smoky Mountain National Park	Elizabethton, Tenn.	Texas Coastal Region	Dallas, Texas	Rosedale, Miss.	Pensacola, Florida	Carolinas Region
Whip-poor-will.....	—	April 17	May 3	winters	—	April 13	winters	April 6
Nighthawk.....	—	June 3	April 25	April 13	April 8	March 29	March 16	April 8
Chimney Swift.....	April 7	April 6	April 6	April 15	April 30	—	—	April 3-7
Least Flycatcher.....	—	May 3	May 2	April 13	—	—	April 17	—
Wood Pewee.....	April 30	April 26	April 13	April 16	May 4	March 29	—	—
Cliff Swallow.....	—	—	April 27	April 16	May 7	April 13	winters	—
Catbird.....	April 30	April 22	April 22	winters	March 27	—	winters	—
Blue-gray Gnatcatcher.....	April 6	April 6	April 6	March 20*	March 30	March 29	winters	—
White-eyed Vireo.....	April 10	April 7	April 12	March 23	May 12	—	winters	—
Yellow-throated Vireo.....	April 22	April 7	April 27	winters	March 12	winters	March 26	—
Blue-headed Vireo.....	—	April 22	April 24	March 30	April 26	March 29	March 24	March 16*
Red-eyed Vireo.....	April 21	April 4	April 13	March 13*	May 10	—	March 23	March 26
Black and White Warbler.....	April 13	—	—	—	—	—	—	—
Prothonotary Warbler.....	April 30	April 26	May 2	March 21	—	—	—	—
Worm-eating Warbler.....	May 4	April 20	April 26	April 13	—	April 3	March 16	—
Golden-winged Warbler.....	—	April 22	April 20	March 3	—	—	May 4	—
Parula Warbler.....	—	—	April 26	April 25	May 12	April 13	—	—
Magnolia Warbler.....	May 3	—	April 24	March 24	May 9	—	—	—
Black-throated Green Warbler.....	April 6	April 22	April 26	April 20	May 9	—	—	—
Blackburnian Warbler.....	May 1	April 22	April 26	—	—	—	winters	March 30
Palm Warbler.....	March 10	April 22	April 24	April 13	—	—	April 16	—
Oven-bird.....	April 13	March 30	—	March 29	—	—	—	—
Northern Water-thrush.....	—	—	—	March 30	—	—	—	—
Louisiana Water-thrush.....	April 23	April 26	April 6	March 30	—	—	—	—
Kentucky Warbler.....	April 21	April 20	April 13	March 24	—	April 3	April 17	April 7
Yellow-throat.....	April 20	April 20	April 20	winters	April 25	April 3	winters	—
Hooded Warbler.....	April 17	April 12	April 20	March 29	—	April 3	March 16	—
American Redstart.....	April 18	April 13	April 20	April 13	May 7	April 13	April 14	—
Orchard Oriole.....	—	—	—	—	—	—	—	—
Scarlet Tanager.....	April 17	April 18	April 26	April 13	—	—	April 14	April 19
Summer Tanager.....	April 16	April 16	April 27	March 30	?	April 25	April 2	April 6

\* One or more records during the winter of 1946-1947.

Thus, as far as the Great Lakes Region is concerned, the area of flight termination appeared to center along a relatively narrow belt connecting Toledo and Toronto, barely broad enough to include Detroit and Buffalo, but excluding Rochester where Edson (1947) reported no similar occurrences. However, beyond that belt, there were isolated occurrences as far west as Chicago, north to Georgian Bay and northeast to Ottawa.

It is interesting to note that virtually all these occurrences took place at, or close to, the edge of a large body of water. The sparsity of comparable observations from inland points is indicated by the reports from London, Ontario, a city lying close to the Toledo-Toronto line, but about 20-25 miles inland from Lake Erie. There an active group of field ornithologists found no comparable occurrences during the period in question. To the south, as will further be shown, it is necessary to go far inland before any comparable occurrences are encountered.

Unusual species observed at three or more points in the Great Lakes Region were: Chimney Swift, *Chaetura pelagica*; Blue-gray Gnatcatcher, *Poliophtila caerulea*; Red-eyed Vireo; Black and White Warbler, *Mniotilta varia*; and Hooded Warbler. The Hooded Warbler was reported on April 6 at Chicago, Detroit, Port Dover, Ont., Buffalo, and Toronto (April 8 at Toledo) and appears to have been an important component of the wave. Warblers (8 species) and vireos (4 species) comprise 12 of the 20 species listed in Table 3 for the Great Lakes Region within the period April 5-9.

Table 3 does not indicate the number of individuals of a species seen on the date given. In many instances, the records represent single individuals, seldom more than three or four. Thus the wave in the Great Lakes Region, for all its diversity, need not necessarily have been larger than a few score to a few hundred birds.

A further point of interest is that the Toledo birds were no longer to be found two or three days after they were first observed. This was not universally the case at Toronto, where Hooded Warblers, for instance, were seen almost daily until early June in High Park.

South of Lake Erie, one might have expected numerous records of a similar nature in Ohio, but they were in fact remarkably scarce. However, the following four relevant occurrences are listed for central Ohio in Table 3: Blue-gray Gnatcatcher, April 6; Black and White Warbler, April 5; Chimney Swift, April 6; and Prothonotary Warbler, *Protonotaria citrea*, April 6. Borror (1950) has listed the last three dates as being the earliest spring arrival occurrences for these species on local record.

An outstanding feature of Table 3 is the early wave of warblers reported in West Virginia. It is important to note that some of these arrival dates are earlier than those for the Great Lakes by a clear margin of two days. Further, this wave was distinctive in that it was restricted primarily to warblers and included several species not seen along the Great Lakes.

Eastward from West Virginia, Robbins (1949) has shown that Washington, D. C., experienced a heavy migration wave on April 6 and 7, but it consisted chiefly of species arriving at normal or near normal dates. In addition, however, the recording of Whip-poor-will, *Caprimulgus vociferus*, Chimney Swift, Louisiana Water-thrush, *Seiurus motacilla*, and an adult male Orchard Oriole, *Icterus spurius*, showed a positive relationship with the unusual observations to the west and northwest.

Northeast of Washington, along the Atlantic seaboard, where Massachusetts records are fairly representative, a heavy wave of migrants was similarly reported April 6 to 9, but again these were chiefly species which were to be expected at this date and included only two of the species listed in Table 3.

Table 3 lists arrival dates for three locations in Kentucky and four in Tennessee. These are remarkable in that they show that seven of the nine species of warblers encountered in West Virginia on April 3-6 were still conspicuously absent from Kentucky and Tennessee at that time. However, there was a scattering of records for April 4-7 (principally on April 6 and 7) in which the species figuring most prominently were: Chimney Swift, Blue-gray Gnatcatcher, White-eyed Vireo, Black and White Warbler, Black-throated Green Warbler, *Dendroica virens*, and Louisiana Water-thrush. Of the seven locations in the two states, only the most southwesterly one, Memphis, reported a small influx on March 30, when the Chimney Swift, Blue-gray Gnatcatcher, and Black and White Warbler were noted.

Of the warblers which were not reported in Kentucky and Tennessee until after April 6, the most interesting case is undoubtedly that of the Hooded Warbler. It was seen at Madisonville on April 7 and at Memphis on April 8, but the other five stations did not report it until April 12 or even considerably later.

Table 3 lists some particularly significant observations from Rose-dale, Mississippi, in the Mississippi valley some 350 miles north of the Gulf. Four of the species in Table 3 were first observed there on March 29 and an additional six, including the Hooded Warbler, were added on April 3. These were the records of a single observer, Mr. M. G. Vaiden, and it is of some interest that he was able to note a

third of the species given for the Great Lakes Region and West Virginia a very few days before they were reported far to the north.

On the Gulf itself, all observers are agreed that only the early records are of any particular significance, late records indicating merely that the birds have flown inland without stopping. At Pensacola, Florida, Weston (1947) indicated a brief flurry in which four of the listed species, including the Hooded Warbler, were observed on March 16. In the case of the Hooded Warbler, this date was three days earlier than recorded in any previous year. Williams (1947) ably analysed the arrival of the early waves along the Texas coastal region and their relation to weather conditions. The Hooded Warbler was first seen there on March 29 and a number of the other species were recorded either on March 20-22 or March 29-30. The situation along the Gulf is complicated by the fact that individuals of at least eight of the species in Table 3 winter there.

When considered as a whole, then, the observations summarized here for the early April period of 1947 from eastern North America reveal a chronological and geographical dispersal of migrants which is not only unusual, but apparently unique as far as the published literature on ornithology is concerned. That being the case, it is pertinent, as Williams (1950) has stressed, to examine the day-to-day meteorological conditions of the period to determine what correlation exists between the two.

#### METEOROLOGICAL DATA

In order that non-meteorologists may comprehend the discussion and diagrams, a brief explanation of meteorological terms and symbols is given here.

*Explanation of Meteorological Terms and Symbols.*—The analysis of modern weather maps recognizes the existence of large bodies of air which approximate horizontal homogeneity. Any one of these large bodies of air covers thousands of square miles of the earth's surface and is referred to as an *air mass*. Between two different types of air masses, each of which is itself quasi-homogeneous at any fixed level, there is a sloping surface of discontinuity known as a *frontal surface*. The intersection of a frontal surface with the surface of the earth is termed a *front*.

Air masses acquire their characteristic properties of temperature and moisture content according to the section of the earth's surface with which they have been in contact. They naturally divide themselves, for classification purposes, into two main types: (a) *Tropical air masses* in which the air remains at low latitudes for a considerable period of time; and (b) *Polar air masses* in which the air remains at

high latitudes for a considerable period of time. Air masses are further classified according to whether they originated over land or water surfaces.

In accordance with the above, it may be stated that the air masses usually to be found on the North American continent are: 1) Maritime Tropical; 2) Maritime Polar; and 3) Continental Polar. In Figures 1-4 and Table 4, these air masses are respectively represented by the following symbols: mT, mP, and cP.

Weather maps commonly indicate the position of moving areas of high and low barometric pressure. The *millibar* is the unit now commonly used to express atmospheric pressures. One hundred millibars are almost equal to the pressure exerted by three inches of mercury. Winds blow in a clockwise direction around centers of high pressure and counter-clockwise around centers of low pressure.

On the weather maps of Figures 1-4, solid lines represent *isobars* or lines of equal pressure. A line with triangular points represents a *cold front*—the leading edge at the surface of the earth of a moving air mass which is colder than the air it is displacing. A line with half circles represents a *warm front*—the retreating edge of a moving mass of relatively cold air. A line with alternate triangular points and half circles represents a *quasi-stationary front*—the forward edge of a relatively stationary cold air mass.

It is a common occurrence for a center of low pressure to develop at the junction of a warm and a cold front. The pronounced sector of a low pressure area between a warm front and a cold front is termed the *warm sector*.

Wind direction at 2,000 feet above mean sea level (as distinct from surface level) is indicated on the figures by shafts which extend outwards from the station in the direction from which the wind is blowing. Wind strength is indicated by full barbs and half barbs attached to the end of the wind shaft; each full barb represents 10 miles per hour of wind and each half-barb represents 5 miles per hour of wind. The strength of the wind is inversely proportional to the distance apart of the isobars. It may also be noted that the isobars represent the wind direction and speed at approximately 2,000 feet above ground level. At the surface of the earth, the winds are frequently only about 70 per cent of the wind strength indicated by the spacing of the isobars and turn by approximately 30 degrees to blow in towards a trough of low pressure.

*Recent Concepts Relating Migration and Barometric Pressure Patterns.*  
—In considering the actual meteorological conditions prevailing during the particular period under consideration, it is important to



bear in mind certain recently-stated concepts relating migration and weather fronts in eastern North America, and for this reason they are briefly re-stated here:

(1) Both Williams (1945) and Lowery (1945) emphasized the fact that, in the Gulf Coast Region, migrants in motion are precipitated to earth by the arrival of a cold front. Lowery (1945) also indicated that, in favorable weather, migrants may travel several hundred miles inland before alighting.

(2) Bagg (1948) stated that "There is a particular barometric pressure-pattern in North American weather which stimulates spring migration into New England and adjacent sections of the Northeast." (It is of interest to note that Bagg selected as an example of "the ideal pattern" the exact situation considered in this paper. He specifically cited the weather map illustrated here as Figure 4).

"The ideal pattern is well indicated on the U. S. Weather Bureau's map for 1:30 a. m. on April 6, 1947, wherein a high pressure area is moving eastward off the southeast U. S. coast, while a low pressure area is moving into the Great Lakes region after having originated in the vicinity of Kansas and Colorado.

"The favorable situation prevailing on April 6, 1947 (and other dates during that spring) was initiated by the clock-wise effect of the 'high' which set up a northeastward flow of warm air from the Gulf to New England. This flow subsequently was intensified by the counter-clockwise effect of the adjacent 'low'."

Bagg and collaborators (1950) have subsequently set forth the more general hypothesis that, while some spring migration may be expected in and through regions covered by the westward side of a high pressure area, pronounced migration will take place into or through regions covered by the warm sector of a low pressure area.

(3) Robbins (1949) showed that the arrival of spring migrants at Washington, D. C., was closely correlated with southwest winds and a rising minimum temperature, this being particularly applicable when considering the spring advent of Mississippi flyway species to the Washington region.

(4) Williams (1950) made the point that migrants probably find it difficult to land safely on a dark night, particularly if the wind velocity is high, and that when the adverse flying conditions of a cold front are then encountered, they may be forced to fly as much as hundreds of miles off-course before there is sufficient visibility to permit a safe landing.

*Periods of Influx of Tropical Air in March, 1947.*—Since many of the species under consideration normally reach the southern United

States in March, it is worth noting that there were three periods in March, 1947, during which there was a northward flow of tropical air from the Gulf, bringing southerly winds, warmer temperatures and, presumably, migrants from South and Central America. These three periods occurred on *March 12-14*, *March 22-25*, and *March 27-28*. In the first and third periods, weak northward thrusts of tropical air reached the Gulf states but did not penetrate north of latitude 35° N. (southern Tennessee) while over this continent. During the second period, an extensive area of the eastern United States was covered by tropical air, but this originated primarily from a flow of air from the Pacific Ocean which supplanted the northward flow from the Gulf, leaving the latter to persist only in Louisiana and southern Alabama.

*Meteorological Conditions, April 1 to 7, 1947.*—The beginnings of the storm of April 4-7 were not much in evidence before April 3 but, because of the early West Virginia records, it was thought best to review the meteorological conditions from April 1 until the dissipation of the storm on April 7. Limitations of space make it impractical to deal in detail with the meteorological aspects of the entire period. However, the relationship between the rapidly changing weather conditions of the period and the degree of migration that might theoretically be expected is indicated in Table 4. In a subsequent section, some comparisons are made to see whether theory fits the known facts. Simplified versions of synoptic weather maps for important stages of this period are presented in Figures 1-4.

An analysis of the development and course of the storm itself is here briefly summarized.

On April 3, almost the entire continent was covered by polar air. A center of high pressure, located in central Ontario, was moving slowly eastward, and a second similar center was located in the Yukon. The only center of low pressure was situated in Utah. It was the subsequent motion and development of these centers of high and low pressure areas which resulted in the storm.

On April 4, as the deepening low center moved eastward, a warm sector of tropical air was gaining prominence as it moved northeast over Texas and Oklahoma. By 1:30 a. m., E. S. T., on April 5, the low pressure area exhibited a complex double center over the state of Kansas (Fig. 2).

With the passing of the Ontario high pressure area to the southeast, the direction of the winds in the lower levels of the atmosphere changed from easterly to southerly over the eastern sections of the continent and at the same time increased greatly in strength. Winds of 40 m. p. h. at 2,000 feet above mean sea level are common in Figure 2.

TABLE 4

DISTRIBUTION AND MOVEMENT OF AIR MASSES OVER SECTIONS OF SOUTH-CENTRAL AND SOUTHEASTERN NORTH AMERICA DURING THE PERIOD APRIL 1-7, 1947, AND THEIR PROBABLE RELATION TO BIRD MIGRATION

Date	Region	Air mass	Metecorological synopsis	Conditions for migration
April 1	Eastern U. S., Lake Erie to Fla.	cP	west side of High	moderately favorable
	E. Texas, part Okla. and La.	mT	warm sector of southern Low	very favorable
	Mid-west, Minn. to w. Texas	cP	behind cold fronts	unfavorable
April 2	West Va. and neighboring states (Fig. 1)	mP	warm sector of northern Low, followed by cold front	favorable till mid-afternoon, then unfavorable?
	Lakes Erie and Ontario (Fig. 1)	cP	cold air north of Low center	unfavorable
April 3	U. S. east of Miss. Valley	cP	se. part of High	unfavorable
	Texas and w. Oklahoma	mT	warm sector of developing Low	favorable
April 4	U. S. east of Ohio-Florida line	mP	south to south-western part of High	becoming somewhat favorable
	Texas, La., Ark., Miss., and s. Mo.	mT	warm sector of Low	very favorable
April 5 1:30 a. m., E. S. T.	Ill., Ind., Ohio, West Va., Ky., and most of Tenn. (Fig. 2)	mP	southerly winds ahead of warm sector; rain.	favorable
	S. Mo. south to Gulf from e. Texas to Ala. (Fig. 2)	mT	warm sector of Low	very favorable
April 5 1:30 p. m., E. S. T.	S. Mich. and from s. Ontario se. to Md. and Va. (Fig. 3)	mP	southerly winds ahead of warm sector; rain	favorable
	E. Ill., Ind., Ohio, West Va., Ky., Tenn., Miss., Ala. (Fig. 3)	mT	warm sector of Low	very favorable
	Okla., Ark. and w. La. (Fig. 3)	mP	cooler air; high winds	???
April 6 1:30 a. m., E. S. T.	C. New York, e. Penn., e. West Va. and Atlantic seaboard from N. Jersey to S. Carolina (Fig. 4)	mT	warm sector of Low	very favorable
	Mich., s. Ont., w. New York, and sw. in a broad arc to Ark. and La. (Fig. 4)	mP	cooler air; high winds	???
April 6 1:30 p. m., E. S. T.	Ill., Mo., Wis. (Fig. 4)	cP	cold air	unfavorable
	Vermont, N. Hampshire, and Atlantic seaboard, Mass. to Ga.	mT	warm sector of Low	very favorable
	S. Ontario, Ind., Ohio, West Va., and s. to Ala. and La.	mP	cooler air between 1st and 2nd cold fronts	???
April 7, 1:30 a. m., E. S. T.	Wis., Ill., Mo.	cP	cold air behind 2nd cold front	unfavorable
	Atlantic seaboard, N. Jersey to Carolinas	mP	cooler air between 1st and 2nd cold fronts	???
	NE. U. S. n. of line from Mass. to Okla.	cP	cold air behind 2nd cold front	unfavorable



On the night of April 4-5, as is shown in Figure 2, a warm front from the more easterly center of low pressure in Kansas lay through Missouri, western Tennessee, and Alabama. North and east of the warm front, such states as Tennessee, Kentucky, and much of Indiana and Ohio were covered by a mass of maritime polar air bringing rising temperatures along with the strong southerly winds. Throughout most of this region, clouds at the 1,000- to 2,000-foot level created an overcast condition which reduced or nullified the increased visibility that would otherwise have been provided by the full moon. The air was clear, however, and visibility in the region was officially recorded as ranging from six to 30 miles. To the west and southwest of the warm front lay the region covered by tropical air, by then including Arkansas, Louisiana, Mississippi, and southern Missouri. Cloud cover there was at the same level but less dense and broken in places.

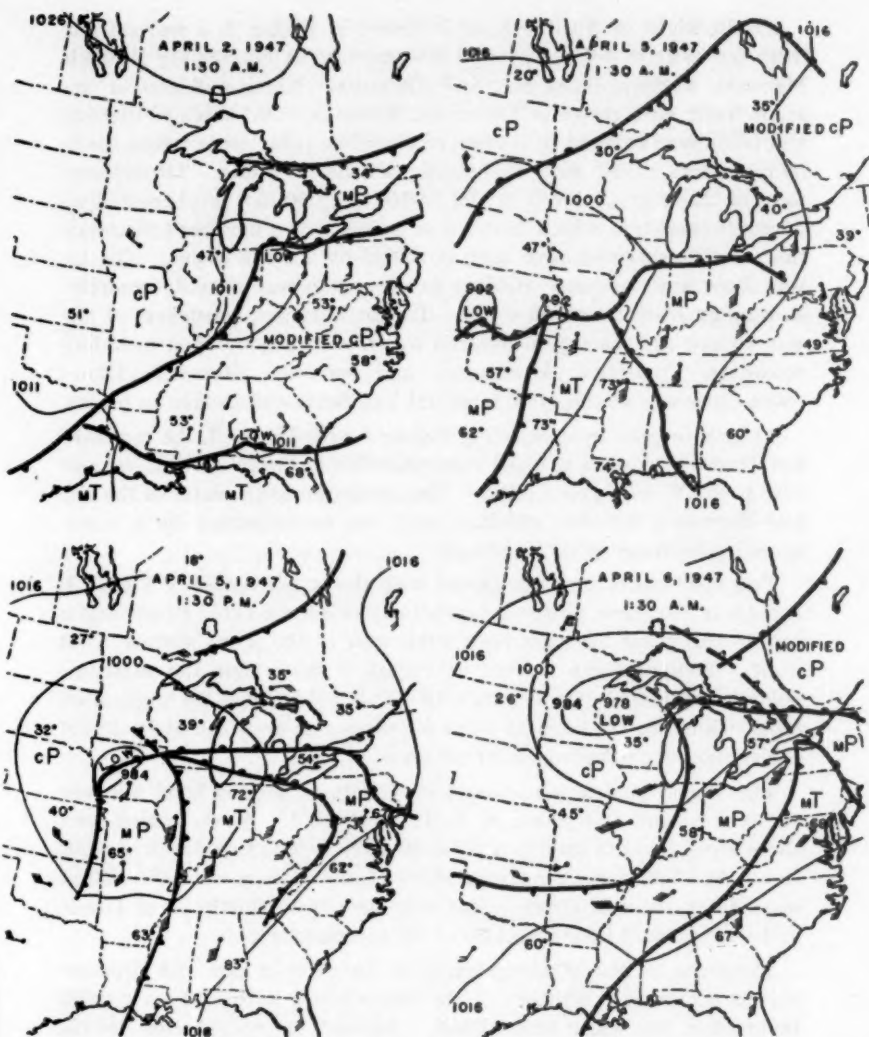
As may be seen by comparing Figure 2 with Figure 3, the center of low pressure showed marked intensification between 1:30 a. m. and 1:30 p. m., E. S. T., on April 5. The pressure at the center of the low had decreased by nine millibars and was accompanied by a corresponding increase in wind strength.

Two cold fronts were associated with the storm center of Figure 3. A mass of maritime polar air lay between these two cold fronts and a continental polar air mass lay to the west of the more westerly cold front. Temperatures plotted in Figure 3 show that the maritime polar air mass was approximately 10-15° F. colder than the tropical air mass, while the continental polar air mass was approximately 20-25° colder than the maritime polar air mass.

The warm tropical air arrived at Toledo at ground level between 10:30 a. m. and 1:30 p. m., E. S. T., on April 5. At the earlier hour there was a layer of maritime polar air over Toledo to a depth of 6,000 feet. At 10:30 a. m. the temperature at the surface was 54°. Three hours later, the cold air mass had retreated to the northeast of Toledo and was replaced by tropical air of 71° temperature.

Moderate to heavy precipitation in the form of rain and thunderstorms occurred in advance of the warm front, with little or no rain reported in the warm sector itself. Amount of precipitation, for the six-hour period ending at 1:30 p. m. April 5, at stations in advance of the warm front were: London, Ontario, 0.98 inches; Erie, Penn., 1.80; and Buffalo, N. Y., 0.62 inches.

Visibility in the warm sector at 1:30 p. m. April 5 was of the order of 15 miles or better. Ahead of the warm front, visibilities of two to five miles were common and locally ranged as low as zero.



FIGURES 1-4. Maps to show weather conditions from April 2 to April 6, 1947.

Toledo remained within the warm sector until about 8:30 p. m. April 5, at which time the maritime polar air mass reached Toledo from the west. The warm front was meanwhile moving slowly northeastward and passed Toronto at about 1:00 a. m. April 6. It was followed almost immediately by the cold front which had passed Toledo in the early evening. Thus, Toronto remained in the warm sector very briefly—for a matter of minutes only.

The position of the warm sector at 1:30 a. m., E. S. T., April 6, is shown in Figure 4. It will be noted that the slowly moving warm front has reached its most northerly position prior to or at the time of this map, since the cold front east of Toronto is moving rapidly eastward and is displacing the tropical air at the ground.

The storm had reached its full intensity by 1:30 a. m. April 6. During the morning of April 6, the winds at Toronto reached 75–80 m. p. h. at a height of 2,000 feet above mean sea level. The storm center itself had moved at a fairly constant speed of 30–35 m. p. h. from 1:30 a. m. April 5 until it reached its lowest pressure (and greatest intensity) in Wisconsin during the early hours of April 6, after which it moved more slowly.

During April 6 the storm gradually diminished in intensity and it lost its identity on the following day. The Atlantic seaboard remained in tropical air until the first cold front swept across the coastline late on April 6. It was closely followed by the second cold front which, as it moved southeastward across the eastern part of the continent, brought in its wake low temperatures and northwesterly winds.

#### DISCUSSION

Dealing first with the March invasions of tropical air, it will be noted that the early records established on March 16 at Pensacola, at the base of the Florida peninsula, coincide well with the arrival of tropical air over the southern part of Florida on March 14.

The extended warm period experienced in the eastern United States on March 22–25 was brought about primarily by an eastward flow of air from the Pacific which cut off a northward flow from the Gulf; this may have discouraged migration far inland from the Gulf, but arrival of migrants on the Gulf coast itself was to be expected and was duly reported by Williams (1947).

The brief influx of tropical air on March 27–28 and the ensuing cold front are reflected in arrivals along the Texas coast reported on March 28–29 by Williams (1947) and by Mr. M. G. Vaiden at Rosedale, Miss., on March 29.

The very similar influx of tropical air on April 1 and 2 is reflected in Mr. Vaiden's additional arrivals reported on April 3. Again, the tropical air penetrated no farther north than the southern border of Tennessee, but on this occasion the contemporary eastward movement of another rather weak low to the north created quite favorable conditions for migration in its warm sector (Fig. 1).

It is the action of this more northerly low that may have brought about the five observations made in West Virginia on April 3 and 4. From a meteorological viewpoint, these are the hardest to interpret, for migration conditions were decidedly unfavorable along the approach to West Virginia from the night of April 2-3 until April 4. However, birds moving northeastward in the warm sector of this low on either the night of April 1-2 or during the day on April 2 might logically reach West Virginia, which was close to the apex of the warm sector on April 2.

Because of both the distance involved and the fact that there were two separate systems of low pressure present between the Gulf and the Great Lakes, it is unlikely that the early West Virginia birds reached there directly from points south of the United States. On the whole, the data in Table 3 support this view. Of the four species involved, there are records for the Black and White Warbler as follows: coastal Texas and Louisville, Ky., on March 13; Pensacola on March 16; Rosedale, Miss., on March 29; and Memphis, Tenn., on March 30; thus for this species the two West Virginia records are not so surprising under the circumstances. The arrival dates of March 16 and 29 for the Hooded Warbler on the Gulf coast have already been mentioned. The Black-throated Green Warbler was reported from coastal Texas on March 24, but there are no other dates in Table 3 as early as that from Morgantown on April 3. For the American Redstart, seen at Morgantown on April 4 and Charleston on April 6, Table 3 shows no other record until more than a week later.

The observations from West Virginia on April 5 and 6 coincided with the improved migration conditions on the night of April 4-5 and the very favorable conditions on April 5-6. While these birds may have arrived earlier, along with those reported on April 3 and 4, the observations from Washington, D. C., on April 5-7 indicate a marked influx of migrants into the general region during this latter period.

Turning now to the wave which reached the southern Great Lakes, the evidence gives little reason to doubt that the intense storm of the period was a basic factor in causing it to end where and when it did. But some doubt remains as to where it began. Inasmuch as the region of precipitation of migrants coincided fairly closely with the

northern limit of the tropical warm front, it might at first be supposed that birds flying from the southeast from some region such as West Virginia were precipitated along an extended line running southwest-northeast across Lake Erie and Lake Ontario. However, in following the movement of the relevant air masses and the wind directions, it seems much more logical that the birds came from the southwest and that the extension of the flight from Toledo east-northeast to Toronto was the result of the high winds which were blowing in exactly that direction on the night of April 5-6.

While the dates in Table 3 do not definitely indicate the starting point or points of the flight, many of the lists are of value in supplying negative information, indicating areas from which it is unlikely that the flight originated. This has tended to narrow down the possibilities. It seems fairly evident that on, say April 4, most of the birds in question were south of Tennessee. Only the Chimney Swift, Blue-gray Gnatcatcher, Black and White Warbler and Palm Warbler, *Dendroica palmarum*, had been reported north of this line. It is also unlikely that they were as far west as Oklahoma or central Texas. Dallas data (Table 3) show that few of these species are regularly recorded there and very few had been seen by that date. On the other hand, the records from Rosedale, Mississippi, show a very fair representation of the species concerned by that date. Therefore, on the basis of the slender evidence available, it seems most likely that many of the birds began their flight from the Mississippi valley south of the southern border of Tennessee. Alabama and Georgia remain as possibilities, but no arrival dates were obtained from these states.

Assuming the region of the state of Mississippi as a starting point for many of the birds, it remains to calculate the period of time and the rate involved. The distance amounts to some 700 miles to Toledo and another 200 miles to Toronto.

The tropical air mass had covered Mississippi by the evening of April 4, producing favorable conditions for a northward flight, but its leading edge did not reach Toledo until about noon on April 5. As the evidence indicates that the birds did not reach Toledo prior to the arrival of the warm front, it can be concluded that the flight was not completed overnight on April 4-5.

Birds travelling partway on the night of April 4-5 and continuing on in the tropical air mass during some part of April 5 could have reached Toledo between noon and 8:30 p. m., while that city was in the warm sector. The single record for April 5 from Toledo, that of a Red-eyed Vireo, suggests that it, at least, arrived within this time period. The bird was observed by Mr. Louis W. Campbell who wrote



that he saw it on Cedar Point, between Maumee Bay and Lake Erie, late in the afternoon when "under the trees the light was beginning to grow dim." However, this was apparently an exceptional case, for the reports indicate that the great majority of the birds reached the Great Lakes Region subsequent to the end of daylight on April 5.

The route could have been covered under purely nocturnal conditions by northward movement on the nights of April 4-5 and 5-6. This may well have been the case in some instances, although data from intermediate points do not support a diurnal stop-over of relevant species in significant numbers on April 5.

A flight begun in the south during daylight on April 5 and carried on into the night of April 5-6 seems rather unlikely for most species listed in Table 3, although it should be considered for such normally diurnal migrants as the Chimney Swift and the Nighthawk, *Chordeiles minor*.

The remaining possibility is that of the journey having been accomplished in a single overnight flight on April 5-6. Although the distance is great, there is considerable support for this theory. Conceding the birds a flying speed of 30 m. p. h. and a favorable wind of 40 m. p. h. (a conservative estimate for that night), these would together realize a net ground speed of 70 m. p. h. Toledo could then have been reached in 10 hours, but it would have taken another 2.5 to 3.0 hours to reach Toronto. Most, if not all, of such a flight would necessarily have taken place in the maritime polar air mass which replaced the tropical air mass over the Mississippi valley during the afternoon of April 5. After exposure to the high temperatures of the tropical air mass during the day, a migration flight in the following polar air mass need not be too surprising, for the temperature of the latter was a still relatively warm 58-60° at 1:30 a. m. on April 6. Wind direction and velocity may well have been the decisive factors. There was little difference in wind direction on either side of the cold front. Once the flight was begun, high winds may have prolonged its duration, for with surface winds reaching 60 m. p. h. or more during the night the dangers involved in landing were undoubtedly high.

One point clearly indicated by the records is that the birds were almost invariably seen within a relatively short distance of a large body of water. The occurrences are clustered on or close to the shores of Lakes Erie and Ontario, with outlying reports from Lake Michigan and Georgian Bay. There are remarkably few inland reports. The significance of this is not clear, but it is possible that the water may have presented a visual barrier or, more likely, that a landing at its edge may have been an easier matter in a high wind.

As a matter of speculation, it is possible that the concentration of records about the cities and towns may have been partly the result of the local influence of the glow of light, reflected from cloud and water, permitting sufficient visibility for a landing under difficult conditions.

Also in Table 3, the heavy movement of Blue-gray Gnatcatchers into Tennessee and Kentucky on April 4-5-6 is clearly shown. These winter chiefly in Florida but westward as far as Texas; the intensity of the storm does not appear to have upset their migration pattern. However, some did turn up at the Great Lakes and these, it is suspected, originated from the southwest rather than the southeast. Later in the month they reached the northern Atlantic states in unusual numbers, as was reported by Griscom (1947).

By contrast, the Hooded Warbler, so conspicuously a feature of the Great Lakes flight, was notably absent from Missouri, Tennessee, and Kentucky during the April 4-6 period. Perhaps these latter regions might well have been the destination of the flight had not the intensity of the storm brought about different results.

In reviewing the relation of the storm to the flight, it can be said that the flight was of a much more unusual nature than the storm. The storm was unusual chiefly in the rapidity with which it developed, in the exceptional depth of the low pressure center, and in the correspondingly high wind velocity. The track of the storm was a common and predictable one. On April 11-12, less than a week later, a similar storm followed a similar path across the continent, although it did not have as deep a low pressure center and wind velocities were not as high. There was no comparable flight of birds to the Great Lakes, and in fact the literature does not indicate any previous flight of a similar nature.

This leads to the speculation that, while the storm undoubtedly had a direct influence in transporting birds so far north and east, some birds of different species were already "reacting" ahead of normal migration pattern, perhaps due to unusual tropical or sub-tropical meteorological conditions. Two facts support this: 1) the warbler flight into West Virginia which was unprecedentedly early and yet which, in its earlier stages at least, was not accompanied by a particularly intense storm such as might readily have accounted for the exceptional northward advance; and 2) a few exceptionally early March records from Pensacola, Florida, hint that some individuals were already migrating ahead of normal schedule.

#### SUMMARY

On April 5-7, 1947, a phenomenally early flight of insectivorous migrants, chiefly warblers and vireos, was recorded along the southern Great Lakes. The greatest number of reports came from Toledo and

Toronto, with lesser numbers from Chicago, Detroit, the north shore of Lake Erie, and Buffalo. These birds arrived, on the average, about three weeks earlier than the previous earliest spring date. The reports are tabulated and compared.

For further comparison, spring arrival dates in 1947 were gathered from some 24 different localities between the Great Lakes and the Gulf of Mexico. An equally surprising flight of warblers showed up in various parts of West Virginia on April 3-6.

The species making up these two flights were, for the most part, still unreported at that time in Kentucky and Tennessee, and it was necessary to go as far south as Mississippi before finding a number of arrival dates prior to April 4. It seems most likely, therefore, that these flights began south of the southern border of Tennessee and that at least the Great Lakes flight originated in the lower Mississippi Valley.

During the period of April 5-7, an intense storm moved northeastward across the continent, bringing with it high wind velocities and, in its warm sector, an invasion of tropical air from the Gulf of Mexico. There seems little doubt that this storm caused the flight to the Great Lakes to end where and when it did. From both the distances involved and the timing of frontal passages, it seems evident that a flight of exceptionally long duration took place on the night of April 5-6 or, alternatively, that part of the flight was diurnal in character. While some birds may have made much of the flight within the warm sector, it is probable that many flew all or most of the distance in the cooler maritime polar air mass which followed the warm sector.

The observations made in West Virginia on April 3 and 4 could not be explained in terms of this storm, but they may have been related to a relatively weak low pressure area which brought light southerly winds and mild temperatures to West Virginia on April 2.

As some exceptionally early migration was taking place even before the storm occurred, it is possible that unusual tropical or sub-tropical influences may have been a prior factor, tending to accelerate migration before the birds reached the United States.

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A MORPHOMETRICAL STUDY OF THE CANADA GOOSE,  
*BRANTA CANADENSIS INTERIOR* TODD

BY HAROLD C. HANSON

THE classification of Canada Geese of the genus *Branta* continues in a state of flux. Responsible in large measure for the lack of agreement among systematists is the dearth of an adequate series of specimens, both adults and downy young, from the breeding grounds. The need for adult specimens from the breeding range is, however, appreciably lessened when sufficient banding is done to show the breeding range of the various wintering populations from which collections are more easily obtained. This is particularly true in eastern North America where the breeding grounds of the various flyway populations are now fairly well understood. It is not true for the populations that migrate across the plains states. Because there has been insufficient banding to show the breeding grounds of these latter populations, a study based on wintering specimens from this area might be misleading. For example, any attempt to unravel the relationship of the various races by the use of specimens from the Gulf Coast would be especially deceiving, for individuals in flocks in that area range in size from that of *Branta canadensis hutchinsii* to *Branta c. interior* or *B. c. moffitti* (Arthur S. Hawkins, personal communication, 1945).

In this study of variation in *Branta c. interior*, the usual handicap of lack of knowledge concerning the origins of the population examined is minimized since the breeding grounds are known with considerable exactness. Findings presented are based on data from a total of 414 geese trapped for banding purposes at Horseshoe Lake, Alexander County, Illinois, in the autumn of 1943. Sex and age of each bird were determined by criteria discussed by Elder (1946) and Hanson (1949a). The segment of the trapped population studied is believed to be, within each sex and age class, a random sample of the Horseshoe Lake flock, which in recent years has comprised about 50 per cent of the Mississippi flyway population. The breeding grounds of the Mississippi flyway population, which are discussed in detail by Hanson and Smith (1950), lie in the muskeg country of northern Ontario, inland from the west coast of James Bay and the south coast of Hudson Bay, between the Albany and Severn rivers.

Geese termed "juveniles" in this report are birds from five to eight months of age; "adults" include all birds 17 or more months of age at time of study. As geese in their second year of life frequently ranked

among the largest in size, it was concluded that a significant difference between the size of yearling adults and older adults probably did not exist.

The writer appreciates the advice on statistical matters received from Mr. H. W. Bean of the College of Agriculture, University of Illinois.

#### LENGTH OF WING (FLATTENED)

The distribution of wing lengths is given in Table 1. In Figure 1 the observed and calculated ranges ( $\pm 3$  standard deviations) and the average of wing lengths for each sex and age class are presented. The difference in wing length between the sexes within each age class proved to be statistically significant, but the difference in wing length between juvenile males and adult females was not statistically significant.

TABLE 1  
DISTRIBUTION OF WING LENGTH IN *Branta canadensis interior* TODD,  
TRAPPED AT HORSESHOE LAKE, ALEXANDER COUNTY, ILLINOIS

Length of wing (mm.)	JUVENILES				ADULTS			
	Males		Females		Males		Females	
	Num- ber	Per cent	Num- ber	Per cent	Num- ber	Per cent	Num- ber	Per cent
410-419			1	1.02				
420-429			1	1.02				
430-439	1	0.88	4	4.08				
440-449			15	15.31				
450-459	2	1.75	22	22.45			4	4.35
460-469	8	7.02	23	23.47	1	0.91	14	15.22
470-479	23	20.18	25	25.51	1	0.91	19	20.65
480-489	31	27.19	7	7.14	7	6.36	33	35.87
490-499	34	29.82			18	16.36	16	17.39
500-509	11	9.65			36	32.73	3	3.26
510-519	4	3.51			29	26.36	1	1.09
520-529					12	10.91	2	2.17
530-539					4	3.64		
540-549					2	1.82		
TOTALS	114	100.00	98	100.00	110	100.00	92	100.00

#### LENGTH OF TAIL

The distribution of tail lengths for each sex and age class is shown in Table 2. In Figure 2 the observed and calculated ranges ( $\pm 3$  standard deviations) and the mean of each class are compared. The difference in tail lengths between each class is statistically significant.

Measurement of tail length in the juvenile age class was complicated because many of the juveniles had moulted the central pair of rectrices, and in some cases the adjoining pair as well, and were in the process of

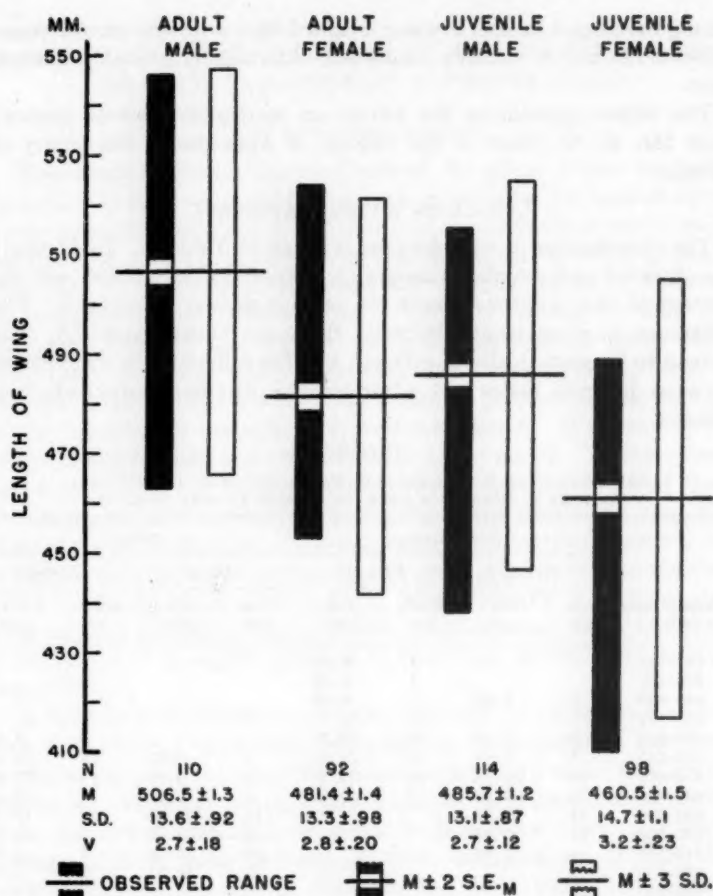


FIGURE 1.—Observed and calculated range and mean wing length of *Branta canadensis interior* by sex and age classes. (Adapted from Cazier and Bacon, 1949.) replacing these lost feathers with broader and longer adult-type tail feathers. While individuals whose tail moult had proceeded beyond the central pair or the adjoining pair of rectrices were excluded from the sample, it was not practical to eliminate all birds whose tail moult involved only the two central pairs of rectrices. In the latter birds, a tail measurement was secured by bunching the rectrices so that their shafts were parallel and then obtaining the greatest projection of the next centermost pair as measured directly out from the tip of the

TABLE 2  
DISTRIBUTION OF TAIL LENGTH IN *Branta canadensis interior* TODD,  
TRAPPED AT HORSESHOE LAKE, ALEXANDER COUNTY, ILLINOIS

Length of tail (mm.)	JUVENILES				ADULTS			
	Males		Females		Males		Females	
	Num- ber	Per cent	Num- ber	Per cent	Num- ber	Per cent	Num- ber	Per cent
105-109			2	2.04				
110-114			10	10.20				
115-119	4	3.60	16	16.33				
120-124	21	18.92	26	26.53				
125-129	41	36.95	26	26.53				
130-134	28	25.23	11	11.23			2	2.20
135-139	10	9.00	7	7.14	1	0.92	19	20.88
140-144	5	4.50			12	11.01	28	30.77
145-149	2	1.80			35	32.11	25	27.47
150-154					26	23.85	10	10.99
155-159					24	22.02	6	6.59
160-164					9	8.26	1	1.10
165-169					2	1.83		
TOTALS	111	100.00	98	100.00	109	100.00	91	100.00

coccyx. While this procedure may at first seem questionable, measurement of a few specimens with entire tails by both methods, assuming in one instance that the central pair of rectrices has been moulted, will show that the difference between the two measurements is not important, approximately 2 to 3 per cent of the total tail length.

#### LENGTH OF EXPOSED CULMEN

The distribution of culmen lengths for each sex and age is shown in Table 3. The observed range, calculated range ( $\pm 3$  standard deviation)

TABLE 3  
DISTRIBUTION OF LENGTH OF EXPOSED CULMEN IN *Branta canadensis interior* TODD,  
TRAPPED AT HORSESHOE LAKE, ALEXANDER COUNTY, ILLINOIS

Length of exposed cul- men (mm.)	JUVENILES				ADULTS			
	Males		Females		Males		Females	
	Num- ber	Per cent	Num- ber	Per cent	Num- ber	Per cent	Num- ber	Per cent
43-44			1	1.02			1	1.09
45-46			9	9.18	1	0.91	7	7.61
47-48	2	1.75	10	10.20	2	1.82	20	21.74
49-50	14	12.28	36	36.24	10	9.09	30	32.60
51-52	27	23.68	24	24.49	19	17.27	21	22.83
53-54	36	31.59	14	14.29	37	33.64	12	13.04
55-56	24	21.05	3	3.06	28	25.45	1	1.09
57-58	8	7.02	1	1.02	9	8.18		
59-60	2	1.75			2	1.82		
61-62	1	0.88			2	1.82		
63-64								
TOTALS	114	100.00	98	100.00	110	100.00	92	100.00

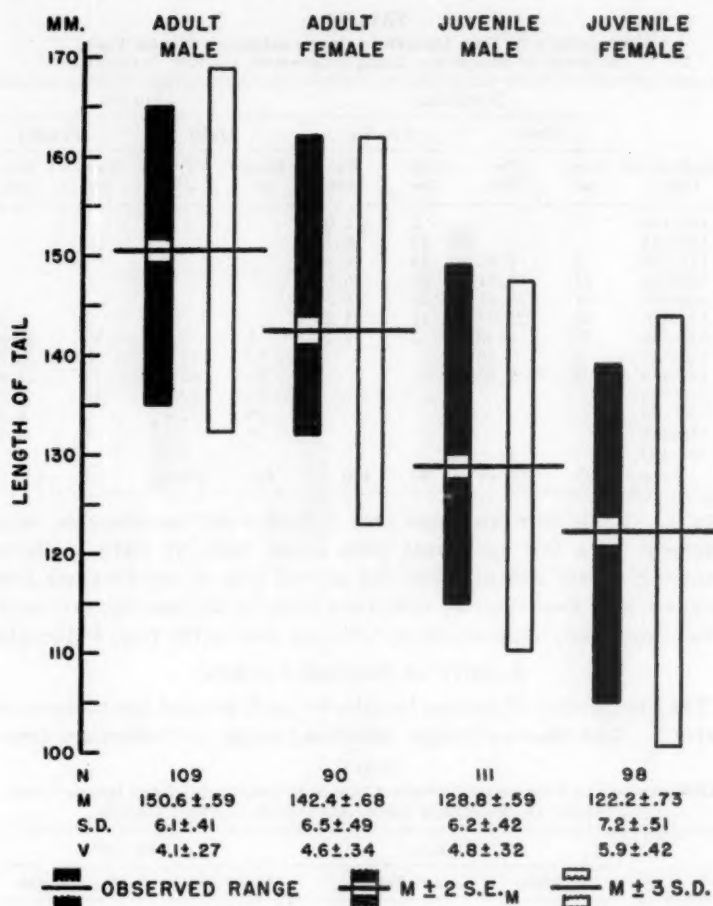


FIGURE 2.—Observed and calculated range and mean of tail length of *Branta canadensis interior* by sex and age classes. (Adapted from Cazier and Bacon, 1949.)

tions), and mean for each sex and age class are presented in Figure 3. The difference in culmen lengths between the two sexes was found to be statistically significant, while the difference between age classes within each sex was not statistically significant.

#### DIFFERENCES ASSOCIATED WITH SEX

Males were found to be significantly larger than females in respect to wing length, tail length, and length of exposed culmen, when the

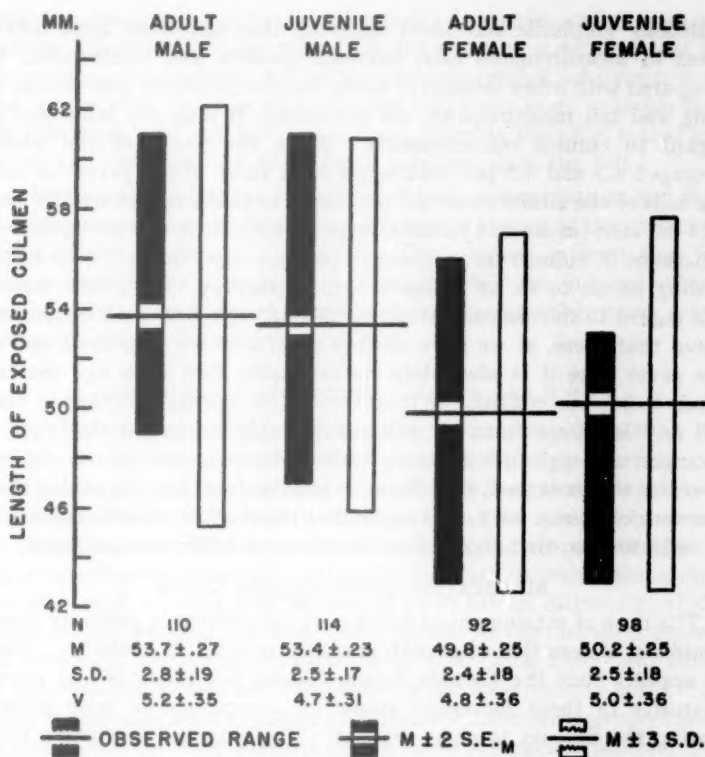


FIGURE 3.—Observed and calculated range and mean of length of exposed culmen of *Branta canadensis interior* by sex and age classes. (Adapted from Cazier and Bacon, 1949.)

comparison was confined to similar age classes. For wing, tail, and culmen length, respectively, adult males averaged 5.2, 5.8, and 7.8 per cent larger than the adult females; for the same measurements, juvenile males averaged 5.4, 5.4, and 6.3 per cent larger than juvenile females.

#### DIFFERENCES ASSOCIATED WITH AGE

The importance of determining the age of specimens in any taxonomic study of allied geese has been stressed by Brooks (1926) "Unless the separation of young from adults is adhered to, the table of measurements will show an amount of overlapping existing in no other groups of birds unless it be the Swans and Cranes, which have a similar longevity and variation in size with age."



Brooks' emphatic statement implying that unusually large differences in measurements exist between juvenile and adult geese, as compared with other families of birds, may be generally true insofar as wing and tail measurements are concerned; it does not hold true in regard to culmen measurements. While the wings of the adults averaged 4.3 and 4.5 per cent larger than those of the juveniles, and the tails of the adults exceeded the length in the juveniles by 16.9 and 16.5 per cent (males and females, respectively), there was no significant difference in culmen measurements between age classes. This latter finding seems to be at variance with Alpheraky (1905) who wrote: "In regard to the dimensions of the bills, it must first of all be remembered that geese, as we have already seen, are very long-lived, and at the same time it is absolutely incontestable that with age the bill tends to become continually longer and more massive, so that in very old and large specimens it will considerably exceed in size that of younger, although fully mature, birds of the same species . . . Moreover, for the most part, it is the more youthful and less shy rather than the very old, very wary, and experienced birds that fall into the hands of collectors, so that short-billed specimens are the most common."

#### MATURATION IN THE CANADA GOOSE

The time of attainment of full size of the culmen is probably representative of cessation of growth in other parts of the skeleton. Thus it appears that the Canada Goose attains full physical and sexual maturity in three successive steps: (1) completion of bone growth during the first six to eight months; (2) attainment of mature body weight by the end of the second autumn, and assumption of adult-type plumage with the renewal of flight feathers after the first eclipse period or when about 14 months of age; this step involves increased pigmentation in the tail feathers and certain other tracts, but paradoxically sometimes depigmentation of some tracts, such as the under wing-coverts (Elder, 1946; Hanson, 1949b); and (3) attainment of sexual maturity, just prior to beginning the third year of life, at least in some cases, and in practically all cases by the beginning of the fourth year of life. The hormonal processes bringing about sexual maturity in females is well under way during the third summer of life since almost all females when about two and one-half years of age have an open oviduct, that is, the occluding membrane over the opening of the oviduct at its juncture with the cloaca has disappeared (Hanson, 1949a).

#### VARIABILITY AND RELATION TO TAXONOMY

In a study of measurements of 20 families of birds treated in Ridgway's 'Birds of Middle and North America,' Bergtold (1925), after



recording the number of times individuals of a species varied from the average, plus or minus by more than ten per cent, concluded that for the purpose of comparing size between closely related subspecies or allied species, the "wing is nine and one half times more valuable than the tail, three and one half times more valuable than the tarsus and eleven and three-quarter times more valuable than the bill. . . ."

A better appraisal of the variability of body measurements and their relative value in taxonomic work is obtained in the use of the coefficient of variability (Figures 1, 2, and 3). These values indicate that the wing is about twice as valuable as the tail, while the tail and culmen appear to be of about equal value for comparing samples of one population of Canada Geese with another.

#### COMPARISONS WITH OTHER SAMPLES AND RACES

The difficulty of collecting and preparing large birds such as the Canada Goose, as well as the cost and problems of storage, as compared with smaller species, has necessarily resulted in limited skin collections of Canada Geese in museums. The question that arises is how well do these limited collections succeed in portraying the distribution of the populations represented. Although there are statistical techniques whereby small samples may be treated to secure an estimation of the actual range (Simpson and Roe, 1939), insofar as the mensural aspects are concerned, taxonomic revisions of Canada Geese have been based on the observed ranges and the means of the specimens at hand. In Table 4, measurements of adults at Horseshoe Lake are compared with measurements of other samples of the same subspecies, *interior*, and with samples of adjacent closely allied subspecies, *canadensis* and *moiffitti*, as presented in the literature. Since some revisers of the genus *Branta* have measured the chord of the wing rather than the flattened wing, a correction factor based on the measurement of 25 adults has been applied to data for the Horseshoe Lake flock in Table 4. It is apparent from the data presented in Table 4 that many samples of *Branta canadensis* have been of inadequate size to approximate the range of the various races and, in some cases, to indicate the true means.

#### SUMMARY AND CONCLUSIONS

The deficiencies in our present understanding of the relationships of the various races of Canada Geese of the genus *Branta* stem in large measure from the lack of sufficient numbers of specimens from the breeding grounds. As the stepped-up tempo of banding operations of waterfowl hastens our knowledge concerning the breeding grounds

TABLE 4  
MEASUREMENTS OF ADULTS OF THE LARGER RACES OF THE CANADA GOOSE,  
*Branta canadensis*

Subspecies	Number measured	Wing (chord)	Tail	Culmen	Authority
MALES					
<i>B. c. interior</i>	9	456.8 (430-473)	143.9 (131-149)	50.7 (46-55.5)	Aldrich, 1946
<i>B. c. interior</i>	109-110	491.6 (448-531)	150.6 (135-165)	53.7 (46-61)	this report
<i>B. c. canadensis</i>	7	466.3 (444-485)	143.0 (131-149)	56.0 (53-58)	Aldrich, 1946
<i>B. c. moffitti</i>	11	502.8 (480-522)	161.1 (144-177)	57.9 (52-68)	Aldrich, 1946
<i>B. c. moffitti</i>	10	500.6 (418-527)	156.8 (134-174)	52.4 (47-55)	Swarth, 1913
FEMALES					
<i>B. c. interior</i>	10	445.5 (427-467)	145.4 (133-155)	49.7 (45-53)	Aldrich, 1946
<i>B. c. interior</i>	90-92	466.4 (438-509)	142.4 (132-162)	49.8 (43-56)	this report
<i>B. c. canadensis</i>	7	465.0 (435-488)	147.3 (134-158)	53.9 (51.5-56.5)	Aldrich, 1946
<i>B. c. moffitti</i>	6	474.3 (435-503)	141.8 (121-166)	54.8 (50-61)	Aldrich, 1946

of the various populations of Canada Geese, the desirability of measuring large numbers of banded geese to gain a better understanding of the size relationships of these races is apparent. Museum collections are often too small to demonstrate adequately the size relationships of most of the races.

The wing, being less variable than either the tail or culmen, is the best criterion of size for comparing samples of the Canada Goose, *Branta canadensis*, of similar age and sex. The tail and the culmen are of about equal value for comparative purposes.

No statistically significant difference could be found, within each sex class, between the juveniles and the adults for mean length of culmen. It would, therefore, seem permissible to combine culmen data for both age classes by sex, when the samples of the adults alone are inadequate.

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*Illinois Natural History Survey, Urbana, Illinois, March 20, 1950.*

THE AFRICAN EMERALD CUCKOO,  
*CHRYSOCOCCYX CUPREUS*

BY R. E. MORREAU AND JAMES P. CHAPIN

*Chrysococcyx cupreus* (Shaw) is a parasitic cuckoo confined to Africa and characteristically belonging to the canopy of evergreen forest. It follows that throughout West Africa it is a lowland bird, but in Abyssinia it is a highland form, inhabiting the forest from 6000 to 10,000 feet (cf. Heuglin *cit.* Reichenow), while in Kenya and Tanganyika Territory it seems almost to be confined to the intermediate altitudes (3000 to 7000 ft.). Farther from the Equator in eastern Africa it inhabits lower country, typically 2000 to 3000 feet in Nyasaland (Belcher, 1930).

In Natal, Vincent (1934: 761) agrees with other authors in regarding the Emerald Cuckoo as a forest bird; but in Portuguese East Africa, as it happens, one of the specimens he collected was in *Brachystegia* and the other (still being fed by a Puffback Shrike) in "thorn and baobab country."

The male is metallic green above, yellow below from the breast downwards. The female is brown above, barred with green, and white below, thickly barred with green. In view of the difficulty of detecting such birds in their evergreen environment, it is impossible to be certain whether they are present or not at seasons when they are not calling, but some definite statements have been made about long-distance migration of Emerald Cuckoos within the African continent. Some recent ornithologists admit three subspecies, others only two, and moreover there is no agreement about the ranges of the described forms, which incidentally do not correspond to the altitudinal differences indicated above. The species has been singularly unfortunate in its treatment in literature, but the nomenclatural difficulties were cleared up by Bannerman (1922), following Grant (1915).

The attention of one of us (R. E. M.) was first drawn to the problems presented by this cuckoo by reports of birds presumably on migration (see below) in the dry thorn-bush of central Tanganyika Territory. It seemed that the alleged migrations of the species might be elucidated and at the same time the geographical variation re-investigated by the help of elementary statistical methods. A special effort was made to use not only the series available in the British Museum and that formerly at Tring, which seem between them to have been the basis of nearly all the previous taxonomic work on the species, but also the specimens possessed by other museums. In correspondence it was

found that the other author (J. P. C.) had important unpublished notes on the species, and the collaboration expressed in the present paper is the outcome.

Our grateful thanks for the loan of specimens are due to Professor J. Berlioz (Paris Museum), Dr. Helge Bergman (Malmö Museum), Dr. V. FitzSimons (Transvaal Museum), Count Nils Gyldenstolpe (Stockholm Museum), Professor F. Olbrechts and Dr. H. Schouteden (Tervuren Museum), Mr. J. L. Peters (Mus. Comp. Zool., Harvard). Professor E. Stresemann and Dr. W. Meise have also contributed measurements and data of Berlin specimens, and Mr. J. G. Williams of the only two males in the Coryndon Museum, Nairobi. We are indebted to Dr. D. J. Finney and Mr. J. M. Hammersley for statistical advice.

#### GEOGRAPHICAL VARIATION

Southwards the species extends to the Cape Province. Its northern limit is a little uncertain but can be approximately determined on ecological grounds. Bannerman (1939) describes it as "primarily a dense forest species which does not occur very far north of the forest belt." This would put the northern limit of the species not far from 8° N. throughout West Africa and in fact the northernmost records are Bates' (1930) (by sound) at Yola in Nigeria at about 9° N. and two Berlin specimens from about 8° 20' N. in the Cameroons (Meise *in litt.*). Farther east there is no record north of the Belgian Congo border (5° N.) except one at 6° N. in the Sudan, and, given the nature of the country, it is improbable that the Emerald Cuckoo does breed north of this. The significance of this point will become apparent when the northern populations of the species are discussed below.

In the extreme northeast of the species' range the same ecological considerations do not hold good because the Abyssinian-Eritrean plateau carries highland forest several hundred miles farther from the Equator, actually to 17° north. Recent authors quote "southern Abyssinia" as the Emerald Cuckoo's northeastern limit and we have not been able to hear of any specimen in existence from north of about 9° N. near the latitude of Addis Ababa; but it is not clear that we are justified in rejecting the definite statement of Heuglin (*cit. Reichenow*), who specified the two localities "Anseba-tal" and "Mareb-tal" (*ca.* 15° N.), that the Emerald Cuckoo extends to 17° N.

The criteria hitherto used by authors in recognizing subspecies of this bird have been, in order of increasing importance attributed to them: barring of female underparts; color of under tail-coverts; and tail-length. All authors have previously been of the opinion that wing-

length does not vary geographically. Actually there is a certain difference of some interest, which will be dealt with briefly. Also, now that better series are available from the Gulf of Guinea islands a character not hitherto recognized in the species becomes evident, namely the pattern of the outer tail-feathers.

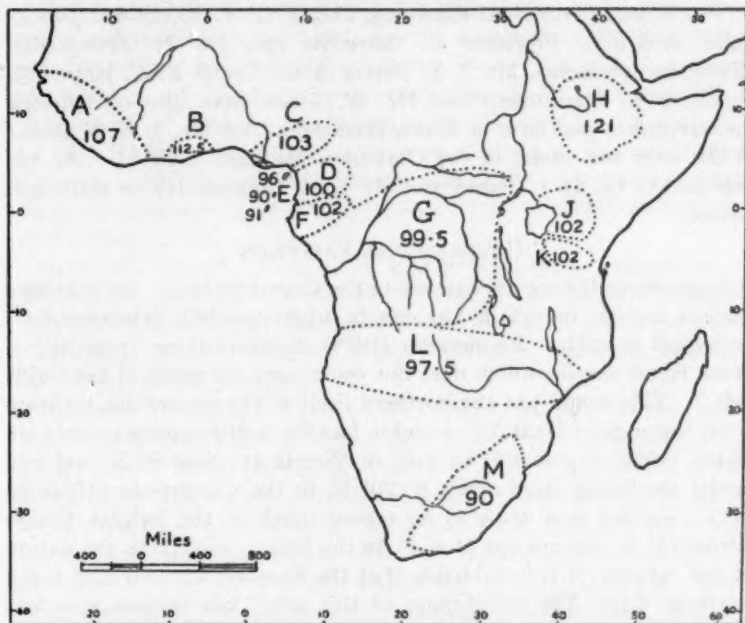


FIGURE 1.—Mean Tail-lengths of Emerald Cuckoo Populations (males). For ranges of length and standard deviations see Table 2.

Ranges and measurements that have been given by various authors are shown below. In no case is there an indication of the frequency distribution within the size-range quoted, and there has apparently been some copying, without specific acknowledgment, from one author to another.

*Chrysococcyx c. cupreus* (Shaw). Type-locality restricted by Grant (1915) to Gambia.

RANGE: "Gambia and south Abyssinia, south to about the Equator [*i. e.* including most of Uganda and Kenya]. Also Fernando Po, São Tomé and Príncipe" (Sclater, 1924).

"From Gambia through the whole of Upper Guinea eastwards to southern Abyssinia" [*i. e.* excluding Kenya and Uganda and the



islands] (Bannerman, 1933). Chapin (1939) agrees. It may be noted that Bannerman's record (*ibid.*) of *C. c. intermedius* from Yola, which is within the area he quotes for *C. c. cupreus*, is due to a misapprehension. The record by Bates (1930), on which Bannerman's is based, was only on having heard this cuckoo at Yola; and hence no subspecific allocation was possible.

"African forest belt from Gambia to Ethiopia, and south to the Ivory Coast, Gold Coast and Southern Nigeria" (Peters, 1940). The wording is unfortunate and the meaning not clear, since there is no "forest belt" (in the usual sense of "evergreen forest") north of the Ivory Coast and Southern Nigeria.

TAIL-LENGTHS: 101-131, av. 112.3 mm., Gambia—S. Nigeria; 99-136, av. 117.2, Abyssinia (Bannerman, 1922). 105-133, Gambia—Gold Coast (Bates, 1930). 101-136 (Chapin, 1939).

*C. c. intermedius* Hartlaub. Type-locality Gaboon.

RANGE: "Gaboon south to Cape Province: south of the Zambesi only from October-March and probably breeding" (Sclater, 1924). "Cameroon to Mt. Elgon and south to southern Angola and the Zambesi" (Chapin, 1939). "Cameroon, Gaboon, São Tomé, Príncipe, Fernando Po, extending east through the Belgian Congo to Kenya and Uganda" (Bannerman, 1933). "Cameroon eastward to Uganda and Kenya Colony, south to Gaboon and southern Belgian Congo; islands of Fernando Po, Príncipe and São Tomé. Recorded from the Tete Province, Mozambique" (Peters, 1940).

TAIL-LENGTHS: Cameroon, Príncipe, São Tomé, 89-105 mm., av. 97.1; Gaboon, 90-107, av. 97; Kenya, Uganda, and Belgian Congo, 86-120, av. 100 (Bannerman, 1922: 417-418). Summarized (*ibid.*: 420) as 97-100 by a clerical error which has been uncritically reproduced by Friedmann and Loveridge (1937). South Cameroon, 98-110 (Bates, 1930). [Entire range] 85-107 (Chapin, 1939). Kenya and Uganda, 102-107, av. 104.5 (van Someren, 1925).

*C. c. sharpei* van Someren (1922). He gives no description in regular form and applies his new name simply to "the South African bird," without designating either type or range. The localities he quotes for it, without explanation, are in Uganda, and are due to a clerical error (van Someren, 1925). Hartert subsequently designated the type-locality as Ifafa R., Natal (Nov. Zool., 32: 154, 1925).

RANGE: "South Africa" (van Someren, 1922). "Angola, Transvaal, Natal" (Bannerman, 1922). "South Angola, Northern Rhodesia (Kafue River and Zambesi District), south through the Transvaal and Natal to Cape Province" (Peters, 1940).

TAIL-LENGTH: 86-98, av. 91 (Bannerman, 1922); "averages 6 or 7 mm. shorter than in *intermedius*," that is, maximum presumably about 100 (Chapin, 1939); 85-94 (Roberts, 1940).

It will be seen that authors disagree about the ranges of all three subspecies to the extent of several hundred miles north and south, and also about the allocation of the insular populations in the Gulf of Guinea.

*The insular populations.*—More extensive series from São Tomé, Príncipe, and Fernando Po are available to us than to previous workers. They show that the birds of the first two islands are in fact distinct from all the continental populations, and not least from those geographically nearest. In the first place the pattern of the outer tail-feathers of the insular birds is peculiar; and secondly, their tails are shorter than those of all others except the South African (difference in means statistically significant,  $P < .01$ ). These insular birds are formally described below.

The Fernando Po population, which is closer inshore than those of the other islands, must be classed as intermediate. The pattern of the outer tail-feathers is not so consistently different from that of the continental birds. Moreover the mean of the tail-length in Fernando Po is not significantly less than that of the opposite mainland (S. Cameroon), and it is not quite significantly greater than that of the outer islands ( $P = .065$ ).

The Emerald Cuckoos of the Gulf of Guinea islands occupy a highly peculiar position in the insular avifaunae. They provide the only example of a land species common to all three islands and of a land subspecies common to two. And there appears to be no parallel case of a Fernando Po population being intermediate between an insular and a continental form.

***Chrysococcyx cupreus insularum*, new subspecies**

DESCRIPTION:—Differs from the races occupying the mainland of Africa by the great reduction of whitish areas on the outer rectrices of adult males, and from all other populations save *C. cupreus sharpei* by the shortness of its tail.

The outermost pair of rectrices is never so regularly barred with white as it is normally in males from the continent. In addition to the white apical spot there frequently are two white areas on the outer web, and these may or may not extend over on to the inner web. There they are apt to become reduced to spots, and never reach the inner margin if the bird is adult. In some males there is almost no

light color except the apical spot; the specimen selected as the type has little more than a suggestion of a white streak along the shaft.

The under tail-coverts of males are very often uniform yellow, sometimes spotted with glossy green, and never barred regularly in adult males. Females are scarcely distinguishable from mainland birds but are heavily barred with glossy green on breast and on wings.

TYPE:—Adult male; Amer. Mus. Nat. Hist., No. 266075; north end of Principe Island; September 27, 1928; collected by J. G. Correia. Wing, 105 mm.; tail, 89 mm.; culmen to base, 20 mm.

RANGE:—Islands of Principe and São Tomé in the Gulf of Guinea. Occasional male specimens from Fernando Po may be found to resemble *insularum*, but the majority have larger white areas on outer rectrices and are better referred to *cupreus*.

*Female plumage.*—Bannerman (1922), van Someren (1922), and Friedmann and Loveridge (1937) all state that the South African females are more "finely" barred (or less "heavily" barred) than "Gaboon" or "northern" birds. It is probable that these views were not all arrived at independently and it is certain that they were not based on adequate series. After examining all the available specimens it appears to us that the distinction has no validity.

*Under tail-coverts.*—Stress has been laid on the fact that the ground color of the under tail-coverts is white in all South African specimens, while yellow occurs in all other areas. The significance of this seemed uncertain because, as Bannerman (1933) points out, fading seems to be important (and most South African specimens happen to be particularly old, over 40 years). In recent months Dr. Herbert Friedmann has examined four fresh skins of adult males of *C. c. sharpei* in South Africa, and he reports that the barring of the under tail-coverts is really white.

The prevalence of marking in the under tail-coverts does, however, show interesting variations. The types into which the under tail-coverts are divisible for the present purposes are: (1) "plain"; (2) "spotted or tipped," which includes those in which the maximum marking on any feather is a single irregular bar entering both vanes; and (3) "barred," in which some feathers have two bars or both spot and bar. The numbers of each of these variants found in the specimens examined for this character are shown in Table 2. It will be seen that plain under tail-coverts do not, as has been suggested, predominate anywhere; there is a significantly small proportion of barred under tail-coverts in Abyssinia and the Gulf of Guinea islands, and a remarkable absence of spotted and plain in South Africa.

*Wing-length.*—Table 1 shows the great extent of the overlap in range of wing-length for all parts of Africa; nevertheless there is geographical variation in the means, which is statistically significant, as confirmed by an analysis of variance ( $P < .001$ ).

TABLE 1  
WING-LENGTH OF MALE EMERALD CUCKOOS

Area	Mean and standard error	Standard deviation	Range	Number specimens
A. Gambia-Sierra Leone	110.3 $\pm$ 0.9	1.5	109-112	3
B. Gold Coast	108.4 $\pm$ 0.9	3.1	103-114	12
C. Nigeria and Cameroons 4°-8° 30' N.	107.3 $\pm$ 2.7	7.2	101-108(114,120)	7
D. S. Cameroons	105.3 $\pm$ 0.5	2.0	102-109	16
E. (i) São Tomé	107.8 $\pm$ 2.1	4.2	102-112	4
(ii) Príncipe	105.7 $\pm$ 1.2	2.4	104-109	4
(ii) Fernando Po	105.3 $\pm$ 0.9	1.5	104-107	3
F. Gaboon	107.2 $\pm$ 0.9	1.9	106-110	4
G. Belgian Congo N. E. 1-4° N.	104.0 $\pm$ 0.7	2.8	101-110	17
S. 6-7° S.	104.5 $\pm$ 0.7	2.5	100-109	14
Other areas	104.3 $\pm$ 0.7	2.9	99-109	17
H. Abyssinia	107.3 $\pm$ 1.1	3.2	104-114	9
J. Kenya and Uganda	110.8 $\pm$ 0.8	3.4	105-118	17
K. Tanganyika	115.0 $\pm$ 0.6	2.0	112-118	10
L. Angola-P. E. A.	109.0 $\pm$ 1.9	5.0	102-114	7
M. South Africa	109.0 $\pm$ 0.7	2.4	105-114	13

Unlike the tails, the wings show no general north-south diminution in length. The shortest wings belong to the birds living in the most completely tropical climate, namely those of the Congo Basin forests; the longest wings are in the mountain forests of northern Tanganyika (ca. 2°-5° S., 3000-7000 ft. a. s. l.), the next longest those of Kenya and Uganda (about 2° S.-2° N., ca. 5000-7000 ft.) which, however, average significantly shorter than the Tanganyika wings ( $P = < .05$ ). Abyssinian birds, which live at still higher altitudes and farther from the Equator, have shorter wings still (though they have the longest tails in Africa, see Table 2). Thus there is no obvious adaptation in wing-length, or regular trend in its variation.

*Tail-length.*—Specimens with any suspicion attaching to locality, maturity, or completeness of tail have been excluded from these statistics. In the course of our investigations it became evident, however, that immaturity of tail (not discernible by pattern or color) may be a more important disturbing factor for the present purpose than had been suspected. Specimens with the slightest sign of immaturity in the body plumage, even a single barred feather on the thighs, were listed separately. It was found that 15 of the 16 so grouped had tails shorter than the average of the population concerned—up to 15 mm.

shorter, even in birds that otherwise appeared practically adult and showed no sign of moult. It is therefore evident that the full-length adult tail is assumed after all the rest of the adult plumage, presumably in the second year, and that there are no infallible means of detecting a specimen with an immature tail. This may well account for some of the outstandingly small measurements in Table 2.

The specimens have been grouped by areas that seemed of possible significance for the present purpose and within which the population seemed fairly homogeneous. It is particularly unfortunate that from between about 6° and 22° S., covering Angola, southern Tanganyika Territory, Nyasaland, and the Rhodesias, there are so few specimens. There is also no adult male from the Anglo-Egyptian Sudan, only one female from Giggling, 6° N. The series of specimens listed therefrom by Sclater and Mackworth-Praed (*Ibis*, 1919: 645) under the heading *C. auratus* Gmel. and therefore purporting to be the species with which we are here concerned, actually are Didric Cuckoos, *C. caprius* (Bodd.). The error was corrected in 'The Ibis' (1920: 853) but unfortunately misled Chapin (1939: 203) into citing them under *C. cupreus* (Shaw).

The measurements obtained for males are shown in Table 2, the areas to which they refer being indicated on the map (Fig. 1). In order to emphasize the main size-range of each population, extremes that are five millimeters or more outside the series are shown in Table 2 in parentheses. Some time after the start of the investigation it was decided also to compare the tail-lengths of females (which are not numerous in collections). The relatively few measurements obtained are given in Table 3. The following points are evident from Tables 2 and 3.

(a) The population with the longest tails is the Abyssinian in the extreme northeast. The next longest are those on the opposite side of the continent, in the Gold Coast and extreme western Africa. The Abyssinian and Gold Coast populations, having the greatest range of length and the greatest standard deviation, are the most heterogeneous. The difference between the Abyssinian mean and the Gold Coast mean is statistically significant ( $P < .05$ ), but that between the Gold Coast and the farther-western population is not.

*Postscript.*—Since the foregoing was completed we have, through the kindness of Dr. Th. Monod, Director of the Institut Français d'Afrique Noire at Dakar, been able to examine a male specimen from about 7° 40' N., 7° 40' E., in Ivory Coast, close to the Liberian border, that is, intermediate between areas A (Gambia-Liberia) and B (Gold Coast) in Table 2. The bird has spotted under tail-coverts, wing, 109, and tail, 125 which is longer than any other specimen but one



TABLE 2  
TAIL-LENGTH OF MALE EMERALD CUCKOOS

	Tail-length in Millimeters			Under tail-coverts			
	Mean and standard error	Standard deviation	Range	Number specimens	Barred	Spotted or tipped	Plain
A. Gambia, Senegal, Liberia, and Sierra Leone	107.4 $\pm$ 2.1	4.6	101-113	5	2	0	2
B. Gold Coast	112.6 $\pm$ 2.7	9.0	(97.5) 103-123 (131)	11	8	2	2
C. S. Nigeria and N. Cameroons 4°-8° 30' N.	103.3 $\pm$ 1.9	5.9	94-108 (116)	10	4	1	0
D. S. Cameroons 3° N.	99.8 $\pm$ 1.2	4.7	95-109	16	8	0	3
E. Gulf of Guinea Islands							
Sko Tomé	91.0 $\pm$ 0.7	4.1	84-102	37	1	1	2
Príncipe	90.2 $\pm$ 1.7	4.4	84-95	7	0	1	3
Fernando Po	95.9 $\pm$ 2.1	4.8	88-100	5	0	3	0
F. Gaboon	102.4 $\pm$ 1.6	6.0	93-110 (116)	14	2	1	2
G. Belgian Congo	99.5 $\pm$ 0.6	4.6	90-110	60	31	10	2
N. E. 1°-4° N.	97.3 $\pm$ 0.8	3.8	90-106	25			
S. 4°-7° S.	101.0 $\pm$ 0.9	4.4	91-108	23			
Other areas	101.1 $\pm$ 1.5	5.2	94-110	12			
H. Abyssinia	120.7 $\pm$ 2.2	9.2	(99) 109-133	17	1	8	3
J. Kenya and Uganda	102.3 $\pm$ 1.0	4.6	90-110	23	11	7	3
K. N. Tanganyika	101.8 $\pm$ 1.5	4.8	95-111	10	2	5	0
Angola,			96, 98, 106	3	1	0	2
N. Rhodesia,	97.5 $\pm$ 1.4	4.0	95.5, 100	2	1	1	0
Nyassaland, and P. E. A.			93, 95, 97	2	2	0	0
M. South Africa	89.9 $\pm$ 4.2	4.2	83-95 (100)	3	14	0	0
				22			



(Gold Coast, 131) from West Africa. However, whether this specimen is included for statistical purposes in area A or area B the conclusions reached above are not affected.

TABLE 3  
TAIL-LENGTH OF FEMALE EMERALD CUCKOOS

Area	Number specimens	Range in millimeters	Mean in millimeters	Standard deviation
Gold Coast	4	(74.5) 80-83	80.2	4.2
S. Cameroons	1	70	—	—
São Tomé	10	67-78	72.7	3.5
Príncipe	1	71	—	—
Fernando Po	3	75-78	76.6	1.5
Sudan	1	80	—	—
Abyssinia	3	85, 90, 96	90.3	5.5
N. E. Belgian Congo	10	70-79	76.1	2.9
South Africa	5	(69.5) 80	77.9	5.0

The Abyssinian females also have longer tails than do those of the Gold Coast. There is actually no overlap in range of lengths, and notwithstanding the small size of the samples the difference between the means is "significant" ( $P < .05$ );

(b) Between the Gold Coast and the Abyssinian population, the Nigerian-North Cameroons population intervenes geographically, with tails averaging much shorter than either (difference significant,  $P < .02$ );

(c) The Abyssinian population shows practically no overlap in tail-length with neighboring birds of Kenya, Uganda, and the Belgian Congo, and the differences between the means are significant ( $P < .001$ );

(d) South African birds have shorter tails than any others on the continent (even those immediately north of the Zambesi), and the difference between the means is significant ( $P < .01$ ). There is, however, a slight overlap between the range of tail-length of South African and other continental populations except those of Abyssinia, Gold Coast, and farther west;

(e) Between the populations of South Cameroons, Belgian Congo, Kenya, Uganda, and northern Tanganyika respectively, together comprising a vast area, there is great overlap in ranges of tail-length and the means vary only from 97.3 to 102.4 mm.;

(f) While there is a general tendency for the longest tails to be in the north of the species' range and the shortest in the south, there is no definite cline. In fact within the Belgian Congo the mean tail-length of the northeastern specimens, 97.3 mm., is significantly less than that of the southern (Kasai), 101.0.

We can now consider to what extent the naming of subspecies within the continent is justified.

(i) It follows from (a) and (b) that several dissimilar populations are included in the generally accepted geographical range of *C. c. cupreus*, namely Gambia to Abyssinia. The name *cupreus* might at first sight be restricted to the Gambia-Gold Coast, but the type locality is Gambia, where the tail-lengths do not differ significantly from those of Nigeria and Cameroons, 4°-8° 30' N., and these latter do not differ from those immediately to the south, hitherto accepted as "*intermedius*." On the whole the birds northwest of the Gulf of Guinea are bigger than those to the south, but in the absence of any distinct trend it seems inappropriate to maintain *intermedius*.

(ii) The Abyssinian population on the other hand is statistically distinct from all others, but it has a big overlap in size-range with that of the Gold Coast. In view of this and of (b) it would be unsound either to name the Abyssinian population or to combine it with the Gold Coast population as a new subspecies.

(iii) South African birds, having shorter tails and uniformly barred under tail-coverts, show a better title to subspecific recognition than any other of the continental populations. Even from the neighboring populations on the north of the Zambesi not only are the means statistically distinct but probably 75 per cent of the individuals are separable.

(iv) On the foregoing basis it seems desirable to drop the use of *intermedius*, to use *cupreus* for all birds north of the Zambesi, even though the dissimilarity between the various populations concerned is recognized, and to retain *sharppei* for the birds on the south of it. The few specimens from about the latitude of the Zambesi River probably reflect the relative scarcity of the species there and make it easier to accept a discontinuity, but bigger collections may ultimately show a cline so smooth that no subspecific limits can be maintained.

#### MIGRATION

Belief in the migration of Emerald Cuckoos has been variously expressed as follows:—

Grant (1915): "breeds in South Africa and winters as far north as Gaboon and perhaps Uganda" (following Bannerman, 1912).

Sclater (1924): "south of the Zambesi only from October to March."

Belcher (1930): in Nyasaland "a summer migrant September to January."

Heuglin *cit.* Reichenow (1900): in Abyssinia it arrives at 10° N. with the first of the rains (April), in fresh plumage, and leaves again in August and September.

Friedmann and Loveridge (1937) remark that "considerable care is required to distinguish birds of Tropical East Africa from wintering South African migrants." (But van Someren (1925) had previously stated that "*C. c. sharpei* does not occur in either East Africa or Uganda.")

Jackson (1938): the species "is probably a regular migrant from South Africa wintering in South Abyssinia."

Winterbottom (1939): in Northern Rhodesia "a wet season visitor only (i. e. November–March), at least for the most part."

Proof of migration requires evidence of one or more of the following phenomena: departure of birds, passage of birds (found either actually travelling or temporarily present in untypical environments), or arrival of birds. In considering this subject it is worth recalling that actual breeding records for this parasitic cuckoo are extremely rare and its full range of hosts is quite unknown; but the local breeding season of the insectivorous passerines of evergreen forest and its immediate neighborhood would certainly be a good indication of the cuckoo's.

*Departure and arrival.*—South Africa is regarded as the source of most migrants. It is a fact that none of the South African specimens we have examined (a large proportion of which are undated) bears a date between March and September, but it is also true that in their evergreen environment Emerald Cuckoos would be very easily overlooked when not calling. Roberts (1940) undoubtedly observes a proper caution when to the statement that there are "no winter records" (i. e. April–August) in South Africa he adds "but then it might be overlooked if silent." This comment applies everywhere. One of us (R. E. M.) noted them year after year at Amani, Tanganyika Territory, from the end of August to early April only, but could never feel satisfied that they were absent during the rest of the year.

In Portuguese East Africa and Nyasaland the bird is not so confined to the period September–January as Belcher thought. Benson (*unpubl.*) now has records in every month but August.

In northern Tanganyika H. F. I. Elliott (*in litt.*) has records for every month except August, with intensive calling September–April (*cf.* Amani data above).

In Kenya and Uganda there are records (mostly specimens) for every month but January and September.

In Abyssinia the Emerald Cuckoo's "season" is not so limited as Heuglin thought. There are also records and specimens for November (Stockholm Museum), December and March (Benson, 1945), so

that the months represented are March to September and also November and December.

The foregoing data may conveniently be plotted in Table 4, in which a solid line represents the period during which a parasite on insectivorous passerines is likely to be breeding (and vocal) in each of the areas (Moreau, *unpubl.*) and a dotted line indicates the other months during which Emerald Cuckoos are also reported.

TABLE 4

Area	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
South Africa (south of Zambesi)												
Nyasaland												
North Tanganyika Territory												
Kenya and Uganda												
Abyssinia												

Solid lines indicate time Passeres are breeding and Cuckoo is always present. Dotted lines indicate additional months in which the Emerald Cuckoo has also been noted.

*Passage records.*—There appear to be no published records of this species obviously or presumably on passage, but some evidence has recently come to light.

Mrs. Koster, who has lived for some years at the semi-arid station Dodoma, in the "thorn-bush" of Ugogo, central Tanganyika Territory, and is familiar with the various African bronze cuckoos, states (*in litt.*) that the Emerald Cuckoo appears in that most unlikely area for about a month every January. This is in the local rainy season, when many of the passerines are breeding, but the Emerald Cuckoos are silent and "always very restless." They frequent particularly the station gardens and the neighborhood of the reservoir, where the vegetation is rather richer than that of the typical surrounding thorn-bush. The old Ugogo record (without date), cited by Reichenow (1902) ostensibly from Emin, is on the face of it a confirmation, but Meise states (*in litt.*) that the record seems to be due to an error on Reichenow's part.

Mr. H. F. I. Elliott reports (*in litt.*) that he has records of this cuckoo in "more or less unsuitable country" (of dry types) between Dodoma and Kilimanjaro (to the north) in December and January, but in no other months.

It seems that these birds seen in thorn-bush are not likely to belong to the Tanganyika breeding population, nor to any of those to the south. They could conceivably come from Kenya or from the Abyssinian highlands. A movement thence at that season would escape

the coldest weather, but it is known that some Emerald Cuckoos are in Abyssinia in December. Collection of some of the Tanganyika "thorn-bush" birds would help to settle the point.

The possibility that South African birds migrate to Abyssinia can be excluded. Only one Abyssinian specimen has under tail-coverts of the South African type, but it has a long tail, 127 mm.; and only one highly abnormal bird in the Abyssinian series has a tail as short as the longest South African, but it has plain under tail-coverts.

The possibility that South African birds reach Kenya or Uganda is not altogether excluded by the available specimens. Two of the 19 Kenya and Uganda specimens taken in June and July have barred under tail-coverts and have tails (91 and 94 mm.) within the South African size-range.

No one seems to have suggested a possible movement of South African birds to the Belgian Congo, but the Tervuren series contains six specimens, collected in May and September in several different localities, which have barred under tail-coverts and tails measuring 91, 95, 97, 98, 99, and 100 mm. The size-range of South African birds given in Table 2 shows that only the first of these is at all likely to have come from there.

#### CONCLUSION

One outcome of this investigation, using more material than hitherto, is to stress the need for caution in naming subspecies mainly on the basis of measurements. The Emerald Cuckoo provides an example of ill-defined and apparently nonadaptive variation, mainly within an ancient continent. It provides, moreover, several instances in which most individuals of two different populations are indistinguishable but in which the means of the populations differ to an extent that is statistically significant. To such populations subspecific names cannot be applied; to use one subspecific name to cover populations known to differ slightly is the only alternative and is the lesser evil.

#### SUMMARY

The characters of the Emerald Cuckoo available for taxonomic purposes are limited to the pattern of the outer tail-feathers, coloration of the under tail-coverts, length of tail, and length of wings. The last two show certain geographical variations of statistical significance, but barring or spotting of the under tail-coverts is not so diagnostic as was formerly believed.

The cuckoos of S o Tomé and Príncipe are described as *C. c. insularum*, on pattern of outer tail-feathers.



Tails tend to be longest in the north, especially in Abyssinia, shortest in South Africa (and on the Guinea Islands). Between most populations there is extensive overlap in range of length, but at the same time the means of some populations differ significantly. From one point of view the range of *C. cupreus cupreus* as at present accepted is too wide because it includes heterogeneous populations; on the other hand, further subspecific division is not desirable. *C. c. intermedius* should be dropped, *C. c. cupreus* extended to the Zambesi, and *C. c. sharpei* retained.

Wing-length varies less than tail-length but the birds of northern Tanganyika and of Kenya-Uganda have (in that order) the longest wings and those of the Congo Basin the shortest.

The extent of migration is still obscure. Specimens give no support to the view that South African birds migrate to Abyssinia, but specimens indistinguishable from South African ones occur in Kenya and the Belgian Congo in the South African non-breeding season. Emerald Cuckoos migrate through central Tanganyika in January but that is the "wrong" date for South African migrants.

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## NOTES ON THE SONG SERIES OF A HERMIT THRUSH IN THE YUKON

BY ANNE HINSHAW WING

A Hermit Thrush, *Hylocichla guttata*, sang in the forest-edge near our camp beside the Teslin river at a point called Johnson's Crossing, Yukon Territory. I listened to its singing whenever possible during the latter half of June, the whole of July, and the first part of August, 1948.

The thrush was a singer of the twilight hours and might be heard for several hours in the evening and early morning and also at other times on cloudy days. Sometimes it sang at so great a distance that the songs were heard only faintly. At other times it sang near by, and the songs were loud and clear. I rarely heard it as late as 11 p. m., although the Olive-backed Thrush sang at midnight. Ordinarily the last song of the Hermit was heard before 10:30 p. m. The singing was often heard about 1:00 a. m. and continued until about 6:00 a. m.

Twilight hours are many in the Arctic, of course, the sunset fading very slowly, the dawn a long, drawn-out affair, and the summer night in June too light at midnight to admit of stars.

I heard it first on the evening of June 21, 1948, soon after our arrival. Between 8:30 and 10:30 p. m. I listened to it, meanwhile working over a pencilled record of the songs heard. It was not easy, for changes of pitch were rapid, and no one song was sung twice in succession. This made it hard to hold a theme in mind long enough to write it down; so I made sure of one or two notes in a song, then changed with the bird to another song, and so forth, until all songs had been made as complete and as accurate as possible.

There were five separate songs, four of which I wrote down as brief melodies, and the fifth as a single note, apparently the opening note of a song too weak for my ear to hear in full. The songs were separated by pauses, a minute more or less in duration and seemingly equal, although no data were gathered on this point. There was a continual change in the order in which the songs were sung, the song to be heard next being unpredictable. On a later evening a count was made of more than 100 successive songs, noting the order in which they occurred. This material is given in a subsequent paragraph.

In discussing the songs I shall call each song by the name of the note or pitch with which it opens. Thus the songs are distinguished by the titles Song B, Song F, Song G sharp, and Song A sharp. The opening note or basal note of each song was long and clear and of greater volume than the succeeding notes which were more rapid and higher in pitch. Upon this basal note the rest of the song was built in the form of harmonizing arpeggios. The Hermit's tone quality was rich and vibrant, the sound carrying a considerable distance. When the bird was singing far away, the song that came most clearly to the ear was that starting on the lowest pitch, Song B. Song D contained more notes than I have shown in the accompanying score, although I believe that all pitches have been represented. The bird alternated pitches so rapidly in this song that to determine the order in which they were sung, the number of times each pitch was heard, and whether the song was always sung in just the same manner was very difficult. Sometimes Song F and Song G sharp were heard to contain additional, rapidly sung intervals like those indicated. However, in no song was the opening note ever repeated or seemingly changed in length or relative volume.

These songs have been examined for evidences of the use of the pentatonic scale of primitive music. This five-toned scale was one of the earliest divisions of the octave in the development of human

music and occurred in ancient Chinese music as far back as the eleventh century B. C. (Tapper and Goetschius, 'Essentials of Music History,' 1917). It still occurs in primitive and semi-civilized music, as well as in folksongs of many nations. Schuyler Mathews wrote of the occurrence of the pentatonic scale in the Hermit Thrush song ('Field Book

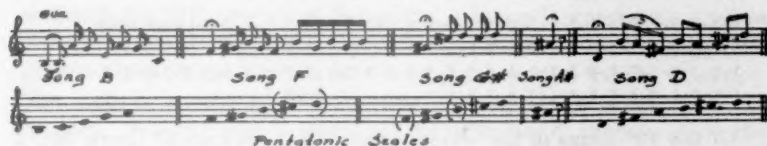


FIGURE 1. Songs of the Hermit Thrush are shown in the first score. In the second score, beneath each song is shown the *pentatonic* or five-toned scale upon which the song is based. Song A sharp (A #) is shown with only one note, the other notes having been too faint to determine. The pentatonic scale of Song D contains a sixth tone one octave higher than the opening note D; this sixth tone may be considered as part of another pentatonic scale an octave higher and of the same formation. Songs F and G # contain together only five tones which may be arranged as shown to form one pentatonic scale.

of Wild Birds and Their Music,' 1921). The Hermit Thrush of Johnson's Crossing used the pentatonic scale with a difference. Whereas the whole tone was accounted the smallest permissible interval in the ancient Chinese scale, the bird used the semitone (as between the notes C sharp and D in Song G sharp).

In working out the use of the pentatonic scale by the Hermit Thrush observed, I noted the relationship between Songs F and G sharp and, while these songs contained only three tones each, I combined them to form a pentatonic or five-toned scale beginning on the note F, five tones in all being included in the two songs. Song D actually contained six tones, but the higher D is herein considered as the beginning of a five-toned scale an octave above (Fig. 1).

The reason for the similarity between the scales of human and avian singers seems to be found in the instinctive nature of musical appreciation. "The historic process of scale-invention is, of course, unconscious. The selection of tones seems to be controlled primarily by an instinctive perception of their harmonic relations to the starting-tone and to each other . . ." (Century Dictionary, 1914 ed.). No measurements were made of the frequencies used by the bird studied at Johnson's Crossing, and it is not known whether there was any deviation from the *exact* or *pure* scale (not the *tempered* scale of the piano and other instruments of fixed pitch, but the natural scale used by singers and violinists, for example, when unaccompanied by an instrument of fixed pitch). However, I found the pitch and the tone-

relationships satisfactory and as indicated on the accompanying score.

On July 4, notes were made on the order of occurrence of 107 successive renditions of the songs of the Hermit Thrush. Song B is considered as No. 1; Song G sharp, No. 2; Song F, No. 3; Song A sharp No. 4; and Song D, No. 5. The songs came in the following order:

1-2-4-5-1-2-5-1-2-1-3-2-5-3-5-3-4-1-2-5-2-1-5-2-1-2-3-pause while flying-1-2-5-3-2-1-5-2-5-3-1-2-5-3-1-3-5-1-5-3-2-5-1-2-5-3-1-5-3-2-1-2-5-3-1-2-5-4-5-1-2-5-3-5-1-3-1-2-5-2-1-5-2-1-3-4-5-1-2-5-1-3-5-2-1-3-2-1-2-3-5-1-2-1-2-5-3-4-5-3- pause, flew off.

Of the 107 songs in the above count, No. 1 appears 27 times, No. 2 appears 27 times, No. 3 appears 20 times, No. 4 appears 5 times, and No. 5 appears 28 times. To show how apparently unpredictable the next song was, the following table has been prepared giving the songs that followed No. 1 in each instance. I repeat that all pauses between songs sounded alike in length and that the selection of Song No. 1 as a starting point was quite arbitrary.

<i>Sequences</i>	<i>Number of times heard</i>
1-2-	2
1-2-3-	1
1-2-3-5-	1
1-2-4-5-	1
1-2-5-	2
1-2-5-2-	2
1-2-5-3-	3
1-2-5-3-2-	1
1-2-5-3-4-2-3-	1
1-2-5-3-5-	1
1-2-5-4-5-	1
1-3-	1
1-3-2-	1
1-3-2-5-3-5-3-4-	1
1-3-4-5-	1
1-3-5-	1
1-3-5-2-	1
1-5-2-	2
1-5-2-5-3-	1
1-5-3-2-	1
1-5-3-2-5-	1

While I have given Song B first place and Song D fifth place, there really was no musical beginning of the series, but only a suggestion of opening and closing songs. The singing went on during a long period, the changes in the order of succession making new effects in harmony and melody. With the possible exception of the single note A sharp, a harmonic relationship could be observed among the songs of the

series. By placing together the other four opening notes B, D, F, and G sharp, as a chord or arpeggio, it will be seen that they form a *diminished seventh* chord or arpeggio. It is interesting to note that two of the completed songs are definitely *major*, the other two *minor*. That is, Song D is unequivocally *major* throughout. Song B is also *major*, although the first two notes, B and the A above it, constitute a minor seventh interval, suggesting a *minor* key; however, as the song progresses there is modulation into a major key, the key of C major. The song is on the whole *major*, or *cheering* in its effect upon the listener. Songs F and G sharp, on the other hand, produce upon the hearer nothing but a *sad* or *minor* effect.

Only the opening or *basal* tone of Song A sharp could be heard clearly, although indistinguishable chiming arpeggios were heard following this tone on one occasion when the bird sang briefly from a nearby tree. However, analysis has shown that each of the other four songs contains tones which form a pentatonic scale with a definite pattern, and it seems reasonable to assume that Song A sharp, if heard more clearly, might also show the tones of a pentatonic scale of similar pattern. Therefore if the song may be supposed to be minor, like the songs F and G sharp, its pentatonic scale would presumably be: A sharp, C sharp, E, F sharp and G, in ascending order. If major, after the manner of the lower pitched songs B and D, its scale would contain the tones A sharp, which is the same tone as B flat, D, F, G and A.

In the course of the series of songs as heard, the following pitches were used, named in ascending order: B, C, D, E, F, F sharp, G, G sharp, A, A sharp, B, C sharp, D. The first B mentioned occurs on the piano as the B at the high end of the octave of which middle C is the lowest note. The final D in the list occurs an octave and three semitones higher than the first B, which was the lowest tone in the series. It will be noted that no D sharp is present. The only significance of such an observation lies in the thought that the missing pitch might be found in the incomplete Song A sharp. (In the accompanying score (Fig. 1) the notes are all shown an octave lower than sung, this fact being remedied by the notation *8va* . . . which places it an octave higher than shown.)

In the Hermit's songs are included a majority of the intervals used by human musicians: diminished second, major second, minor third, major third, major fourth, diminished fifth, major fifth, major sixth, and minor seventh.

*College Station, Texas, September 5, 1950.*



NESTING OF WHITE-NAPED CRANE IN DETROIT  
ZOOLOGICAL PARK, MICHIGAN

BY LAWRENCE H. WALKINSHAW

THE White-naped Crane, *Grus vipio*, is an inhabitant of eastern Asia. Peters (1934: 152) stated that the species was found during the summer "from Transbaikalia and northwestern Mongolia east through Manchuria to Ussuriland." It winters chiefly in Korea, southwest Japan, and middle China to the Yangtze valley. A few winter in Ussuriland (Grote, 1943: 35).

Blaauw (1897: 50) stated that the White-naped Crane bred repeatedly in the Zoological Garden of Amsterdam. It has also bred in Germany (Hagenbeck, 1940: 348-354); here a pair raised two young in 1933 (the year they were brought from Japan), one each year in 1935, 1936 and 1937, and hatched four young (two killed by hail) in 1938 and two in 1939.

In the United States this species has bred in the New York Zoological Park where one young was raised during 1916 and another in 1943 (Crandall, 1944: 125). Keith Kreag (1946: 4) described the first successful nesting at the Detroit Zoological Park in 1946.

This latter pair attempted to nest during 1945 but the nest was deserted when one of the employees went too close to the nest (Theodor Schroder, verbal communication). They had been purchased during 1941. On June 24, 1946, they hatched a single offspring from one of their two eggs and during June, 1947, another. During 1948, they hatched two young. One of the adults died of chicken cholera during the late fall of 1948. This pair raised only the one 1946 young.

## THE NEST

The nest in the wild is usually among the foothill moraines, built in shallow water in the less extensive mountain marshes (Prjevalsky, 1877). Koslova (1935) found it breeding in brush-covered areas.

The four nests built in the large open enclosure of the Detroit Zoological Park have been placed on dry ground. The first two were in practically the same location, about 46 meters from the small lake in the enclosure. The nest in 1947 was even farther from the water. The nest in 1948 was on an "island" almost surrounded by the small lake, but it, like the others, was well up on the higher portion of the ridge. All were well away from the surrounding wall and, as the summer advanced, became better isolated by the tall grass. Apparently all of the nests were constructed with materials at hand—





ADULT WHITE-NAPE CRANE, JULY 4, 1946, DETROIT ZOOLOGICAL PARK, ROYAL OAK, MICHIGAN.



grass and twigs piled into a rather small nest for a crane, not more than one meter in diameter and with very little bulk. In each of these nests two eggs were laid. The incubation period was not determined, but the dates of egg-laying coincided somewhat with the dates the cranes were released into the enclosure.

In 1945, nesting occurred in June. In 1946, one egg hatched June 24, indicating that the eggs were laid about May 25. Blaauw (1897: 50) gave the incubation period as 30 days, as did Hagenbeck (1940). During 1947, Arthur Greenhall and I observed the one young for the first time on June 19. It had been hatched only a few days, indicating that the eggs were laid about May 16. In 1948, the adults were released into the enclosure in mid-April. Both eggs hatched June 1 (Keith Kreag, letter) indicating that the first egg must have been laid about April 30.

In the wild, Prjevalsky (1877) took the earliest young on May 19 at Lake Hanka, and Grote (1943: 35) stated that the young hatch toward the end of May.

According to Theodor Schroder, the eggs were buffy and spotted quite heavily with darker spots.

#### ATTITUDE TOWARD OTHER BIRDS

Several species of cranes were kept in the open enclosure, an area of about 2.4 acres. Two other White-naped Cranes (one raised by the nesting pair in 1946), five Sarus Cranes (*Grus antigone antigone*), two Lilford Cranes (*Grus grus lilfordi*), 13 Demoiselle Cranes (*Anthropoides virgo*), seven Stanley Cranes (*Anthropoides paradisea*), seven Crowned Cranes—five (*Balearica pavonina pavonina*), two (*Balearica pavonina regulorum*)—two Storks, five African Rose Pelicans (*Pelecanus onocrotalus* or *rufescens*), 41 Flamingos of three species (*Phoenicopterus ruber*, *chilensis*, and *antiquorum*), two hen Turkeys (*Meleagris gallopavo*), two African Vultures, three Dorcas gazelles and one mara were also in the enclosure. In addition, several other species of birds at times flew in from other pens. These included the Egyptian Goose (*Alopochen aegyptiacus*), Canada Goose (*Branta canadensis*), Mallard (*Anas platyrhynchos*) and Black Duck (*Anas rubripes*). Several Peacocks (*Pavo*) and Guinea Fowl (*Numida meleagris galeata*) also used the enclosure.

On April 14, 1947, in the winter enclosure, I observed the pair of White-naped Cranes with these other cranes, including their one young of 1946. The male repeatedly chased other cranes away from his mate, even the young bird the pair had raised the previous year.

Outside, in the open enclosure, the behavior of the male and female White-naped Cranes was almost identical. The crane which was not incubating always watched the other birds and mammals. It always remained somewhere near the nest, either in the water, at the feeding area or near by on the island.

If the Dorcas gazelle approached the area, this crane immediately took after it on foot, chasing it to the far corner of the enclosure. If the other two White-naped Cranes approached, they were driven away much more quickly than were other species of birds, except the Stanley Cranes. These latter cranes were attacked with the same vigor. All of the cranes, Lilford, Sarus, Crowned, Demoiselle, and Stanley, were driven away. One pair of Sarus Cranes, especially, and a pair of Lilford Cranes were shown more "respect." Often they approached to within 25 meters of the nest; here the White-naped Crane met them and often herded them back toward the corner by walking back and forth in front of them. Sometimes they did not herd and then were shown more "respect"; at this time the White-naped Crane often laid down on the ground with head erect. There appeared to be a definite boundary where this was done, sometimes by the male and sometimes by the female. At times they were only about four meters from the Sarus Cranes who were always together. When the White-naped Crane did this, the Sarus Cranes called in unison as they stood with heads up and backs to each other.

On one occasion the male Sarus Crane attacked the female White-naped Crane. The male White-naped Crane, which was incubating the eggs, rushed from the nest and both he and his mate attacked the male Sarus Crane with such intensity that he ran to the far corner of the island.

The storks, pelicans, flamingos, geese, sometimes the ducks, the vultures and peacocks were all attacked when they approached the region of the nest, and all showed great "respect" for the pair of White-naped Cranes.

The White-naped Cranes paid little attention to the Guinea Fowl and smaller birds. Often they walked past resting ducks which they had pecked at only a few minutes earlier.

#### ATTITUDE TOWARD EACH OTHER

The crane sitting on the eggs spent nearly all of the time incubating. The other crane of the pair roamed the vicinity, usually preening, feeding, or defending territory. When approaching the nest, it usually moved with head down. When the nest was reached, the head was raised as the other bird stood up. However, only once at the nest

did they call in unison and that was at 4:16 p. m. May 28 when they changed places. The male called a slow 'Groooo-groooo-groooo,' the female a much shriller 'Kuk-kuk-kuk-kuk.' The other time they called in unison was when they drove the male Sarus Crane from their territory. On that occasion they stood with backs toward each other, the male with his tertial feathers arched over his back, neck arched back and bill pointed forward at a 45-degree angle. The female stood with wings down and head and neck straight up. Both called in unison, the male having a deeper call and the female a much shriller one. The calls and the actions were almost identical with those of the pair of Sarus Cranes when they won an earlier bout. This call was given at 1:02 p. m. May 28.

Often when changing places at the nest, the incubating crane turned around and around, working with the eggs while the mate stood patiently within a meter's distance waiting for a turn at incubation. At other times it rose and left the nest and eggs immediately when the other crane approached.

#### BEHAVIOR AT THE NEST

I watched these White-naped Cranes at their nest from daylight until dark on May 28, 1948, and from daylight until 12:30 p. m. on May 29, 1948.

On May 28, 1948, the lowest Detroit temperature was 53° F. at 6 a. m. and the highest 82° F. at 4 p. m., dropping back to 76° at 8 p. m. (Eastern Standard Time). On May 29, 1948, it was much cooler, reaching a high of about 68° F. The sky was clear most of the time on May 28, but was slightly overcast at times, and overcast during the morning of May 29, clearing as the day advanced. There was no rain.

The White-naped Crane when settling down onto the eggs did exactly as other cranes do. One foot was placed on either side of the eggs so that when the bird was down the eggs were between the feet. While sitting on the eggs, the crane often had the head and neck erect. At other times the head was partly tucked into the feathers of the scapular region. This was also the sleeping position on the nest.

When the incubating crane turned the eggs, it stood up. Then, with lowered head it turned the eggs with the bill. Often it turned these many times before settling down, then raised itself several times before appearing to be "satisfied" with its position.

The periods of attentiveness at the nest are given in Table 1. The female White-naped Crane was at the nest May 27 from dark until 8:20 a. m. on May 28, or 230 daylight minutes (probably more than 12 hours altogether). Then, in periods of 57, 58, 55, and 63 minutes, and

one period of 73 minutes, she totaled 536 minutes on the nest between 4:30 a. m. May 28 and 12:30 p. m. May 29.

The male was on the nest for periods of 113, 112, 74, and 65 minutes on May 28 and for 16 hours and 36 minutes during the evening, night and morning of May 28 and 29. In addition, he was at the nest for an unfinished period of 13 minutes between 12:17 and 12:30 p. m. May 29, for a total of 903 daylight minutes and 470 minutes of darkness.

During the above time, the female stood up, preened, turned the eggs, and worked with the nest-material for a total of 25 minutes. These periods on May 28 were between 6:01 a. m. and 4:14 p. m.; the duration of time when she was standing was from 30 seconds to five minutes; the average of 12 times was 125 seconds. The elapsed periods between rising on eight occasions averaged 28 minutes and ranged from one to 114 minutes.

On May 29, the male rose for the first time in the morning at 5:11 a. m. During 15 periods that he was working with the nest and eggs, he was up for an average of 133 seconds (total time, 33 minutes and 25 seconds). The extremes were 30 seconds and four minutes. The average time between the eight times the male rose from the eggs was 80.5 minutes, ranging between 41 and 139 minutes.

During 32 hours, this pair of cranes was at its nest 31 hours and 49 minutes. The other 11 minutes they were only a few meters away. The eggs were actually incubated for 30 hours and 51 minutes. On May 28, the birds left the eggs for only three periods of three, four, and four minutes, respectively.

#### FEEDING, DRINKING, BATHING

On May 28, the female fed chiefly between 8:25 and 9:20 a. m. and 6:45 to 8:40 p. m., and from 4:30 until 10:29 a. m. on May 29. The male fed on May 28 between 5:25 and 7:45 a. m. and then from 5:28 until 5:45 p. m. During the morning of May 29, he fed from 11:10 to 11:35 a. m. The female fed for 197 minutes and the male for 117 minutes during May 28 and the forenoon of May 29.

Most of the feeding was on grain thrown in by the caretaker. Fish were also thrown into the enclosure, but the cranes did not eat many of these. Some were thrown onto the island within 10 meters of the nest. Even of these the cranes did not eat many. The pelicans and the storks worked in swift dashes to get what they could before the cranes chased them away.

Much of the feeding time was spent probing in the earth, apparently for earthworms. Much time was spent capturing grasshoppers and similar insects in the tall grass. Once one of the White-naped Cranes



TABLE I  
ATTENTIVE PERIODS OF WHITE-NAPED CRANE AT NEST IN DETROIT  
ZOOLOGICAL PARK, MAY 28 AND 29, 1948

<i>Female at nest</i>	<i>Female fed</i>	<i>Male at nest</i>	<i>Male fed</i>
MAY 28			
All night until 8:20 a. m. May 28			5:25- 5:40 a. m. 6:45- 7:05 a. m. 7:22- 7:45 a. m.
	8:25-8:45 a. m. 8:48-9:05 a. m. 9:06-9:20 a. m.	8:20-10:13 a. m.	10:17-10:20 a. m.
10:13-11:10 a. m.		11:10 a. m.-1:02 p. m.	1:06- 1:18 p. m.
1:06- 2:04 p. m.	3:02-3:18 p. m.	2:04- 3:18 p. m.	
3:21- 4:16 p. m.	6:45-6:54 p. m. 7:02-7:20 p. m. 7:50-7:52 p. m. 7:53-8:40 p. m.	4:20- 5:25 p. m.	5:28- 5:45 p. m.
5:25- 6:28 p. m.		6:28 p. m. all night until 11:04 a. m. May 29	
MAY 29			
	4:30- 4:46 a. m. 4:48- 4:55 a. m. 7:30- 7:35 a. m. 8:52- 9:02 a. m. 10:13-10:29 a. m.		11:10-11:35 a. m. 12:15-12:17 p. m.
11:04 a. m.-12:17 p. m.		12:17-12:30 p. m.	
TOTAL			
May 28, 463 minutes	143 minutes	364 minutes	90 minutes
May 29, 73 minutes	54 minutes	1009 minutes	27 minutes
Periods ranged in length from 55 minutes to 12 + hours		Periods ranged in length from 65 min- utes to 16 hours and 36 minutes	
Average of 172 minutes for 6 periods (including one night)		Average of 274 minutes for 5 periods (including one night)	

pulled what appeared to be crayfish from the lake bank and threshed it back and forth against some stones before swallowing it entire.

Drinking was in much the same manner as in a chicken—lowering the bill into the water, shovelling it forward to get the water, and then raising it rapidly and swallowing.

The birds bathed once or twice daily. Lowering themselves into the water breast first, the entire body was then lowered so that practically nothing but the neck and head protruded above the water. They remained under water only a few seconds, then rose swiftly, shaking the feathers.

The male left the water where he was roosting on May 28, at 4:30 a. m. On May 29, the female left at 4:30 a. m. She had remained in exactly the same position all night. She stood in water about 20 to 30 centimeters deep and had her head tucked underneath the scapular feathers. She went to roost on May 28 at 8:40 p. m. in the late dusk.

Much of their spare time was spent preening. The feathers of the breast, back, rump, neck and wings were worked over for long periods of time by the standing, non-incubating crane. Occasionally, the incubating crane worked with the feathers of the back, neck, rump, and wing as it sat on the eggs.

#### THE YOUNG BIRDS

At hatching, the young of the White-naped Crane are downy like other baby cranes. They are practically the same color and size as young Sandhill Cranes, *Grus canadensis*. The down along the posterior portion of the head and body and neck is darker brown than the rest of the plumage. When first hatched, the bill and legs are lighter colored than they are later. During the first month the legs become elongated, the "knees" becoming very large. These are still lighter colored throughout than in adults, as is the bill. The down at one month of age becomes more tawny, a little darker on the back than on the lower parts.

During the late summer the young molt into a plumage similar to that of the adults. However, they retain some brown feathers on the side and back of the neck even until the following spring. The white nape is present by three months, but the cheeks are still feathered. By the spring after hatching, the cheeks become bare but not as red as in the adult. On September 28, 1946, when I examined the youngster which hatched June 24, 1946, the eye was still very dark in color, much different from the yellow eye of the adult. By April 14, 1947, this bird had a yellow-colored eye like the adult.

The call of the downy young was similar to that of the downy Sandhill Crane, a plaintive 'Peep' or 'Peer.' This call was given during the first winter, at least until April of the following year.

On September 28, 1946, when the White-naped Crane was three months of age, Keith Kreag and I watched the parents feed it things which they picked from the ground; it also picked up quite a little material.

I wish to thank Mr. Frank G. McInnis, Director, Mr. Theodor Schroder, Mr. Keith Kreag and Mr. Arthur M. Greenhall, all of the Detroit Zoological Park, for helping me in making these studies.

#### SUMMARY

The White-naped Crane bred in the Detroit Zoological Park for four consecutive years, 1945 to 1948. Eggs were laid between April 30 and May 25, approximately. Two eggs were laid in each nest. The eggs were buffy with darker spots, and the nests were built on dry land not far from water. Four young have hatched during three summers, and one was reared to adulthood. Two eggs were deserted.

The young resembled the downy Sandhill Crane during the first month but developed the white nape by three months of age. The one young was driven away by the male, when it was nearly a year old, and was not tolerated near the nest by either the male or female.

Both adults incubated the eggs. On two successive nights, the male incubated one night and the female the other. During 32 hours of observation, the parents were at the nest all but 11 minutes. The female stood up, preened, worked with the eggs and nest for 25 minutes and the male for 33 minutes so that the eggs were actually incubated for 30 hours and 51 minutes of the 32 hours.

Defense activities started even before the adults were released into the open enclosure where they nested. The male would not tolerate other White-naped Cranes approaching closely to his mate. When nesting started, both cranes defended the nest site from other large birds, including all species of cranes in the enclosure, as well as pelicans, flamingos, geese, vultures, peafowls, and storks. Dorcas gazelles were also chased. Actual fights took place between the White-naped Cranes and larger species such as the Sarus Crane. At times both male and female White-naped Cranes laid down on the ground along their definite territorial boundary only a few meters in front of the Sarus Cranes. On one occasion, one left the nest, and both attacked the male Sarus Crane, driving him away.

When calling, the male had a deeper voice. He often raised his tertial feathers over his back and held his head farther back than the female who did not raise her wings but pointed her bill straight up. Voices were not quite as loud as in the Sandhill Cranes. The young gave a plaintive 'Peeer' call and continued this until the following spring.

The female was observed to feed the young when it was three months of age.

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1703 Wolverine Tower, Battle Creek, Michigan, January 31, 1949.

## A PRELIMINARY STUDY OF THE AVIAN ADRENAL

BY FRANK A. HARTMAN AND ROBERT H. ALBERTIN

EXPERIMENTS have demonstrated that the adrenal is as important in birds as it is in mammals. Parkins (1931) reported an average survival of 80 hours following a two-stage adrenalectomy in the fowl. The symptoms resembled those of the cat and dog after a similar operation. Miller and Riddle (1942) were able to maintain young adrenalectomized pigeons an average of nine days by the addition of a salt mixture to their diet. Herrick and Torstveit (1938) destroyed the adrenals in male fowls in which the testes were large. They were given adrenal extract for a few days and then salt solution. Within a few weeks they had the appearance of typical capons, and the testes were reduced to a fraction of their original size, indicating that the adrenals were essential for their normal functioning. Beyond these observations little study has been made of the functions of the adrenal in the bird, but it is presumed that they are similar to those of the mammalian gland. However, more work is needed to demonstrate this.

The adrenal gland is an organ which is called upon in various stresses to increase its activities many-fold (Hartman and Brownell, 1949: 121, 258). No class of vertebrates shows greater range of variety or intensity of stresses to which it is exposed than that of the birds. Therefore, a study of the structure and function of the adrenal in this group should be very profitable.

Riddle (1923) noted the effects of ovulation and disease on adrenal weight in the dove and pigeon. Others have observed the changes in the fowl with age (Hartman and Brownell, 1949: 37). The study of the structure of the avian adrenal has also been limited largely to domestic forms (Hartman and Brownell, 1949: 24 and 56). Aside

from adrenal weights by Crile and Quiring (1940) and Hartman (1946) the adrenal of wild birds has been largely neglected.

A few years ago we began a survey of the adrenal of wild birds as preparation for a more intensive study of selected forms. We have now collected and prepared the adrenals of more than 400 species of birds, half of which were from the tropics, the rest being from the eastern part of the United States. Some of the information which has been obtained will interest ornithologists.

*Acknowledgements.*—We are very much indebted to Mr. Richard Archbold of the Archbold Biological Station, Florida, for his personal assistance in the collection of material and for the use of the facilities of the Archbold Biological Station. We also wish to thank Dr. H. C. Clark for the use of the Gorgas Memorial Field Station in Panama and Mr. James Zetek for his cooperation at the Barro Colorado Island Biological Laboratory. This study has been aided by grants from the Comly Fund and The Graduate School of The Ohio State University.

*Location.*—The adrenals lie under the gonads and against the anterior tips of the kidneys (Fig. 1). They are usually of distinctive color and may be partially or completely covered by the gonads, depending upon the size of the latter. In the female, even the quiescent ovary may cover the left adrenal, being closely adherent to the connective tissue which encompasses the latter. In the male, the immature testes are too small to cover the glands, but the enlarged active testes of the adult do so. A cushion of connective tissue containing fat adheres closely to the dorsal surface of the adrenals.

*Separation.*—In most species the adrenals occur as two distinct organs, but vary in degree of separation from a wide gap to nothing but a line of demarcation. Upon superficial examination these glands, in the latter case, appear to be united, but dissection shows them not to be. Rarely, the adrenal tissue is combined into one organ as in: the Stork, *Euxenura manguari*; Rhea, *Rhea americana*; Gannet, *Sula variegata* (Holmberg and Soler, 1942); and Bald Eagle, *Haliaeetus leucocephalus* (Hartman and Brownell, 1949: 28). Different individuals of the same species may show considerable variation in this respect. Of two Common Loons, *Gavia i. immer*, examined, these glands were fused in one and completely separated in the other. Of nine specimens of the Hairy Woodpecker, *Dendrocopos v. septentrionalis*, they were completely fused in one, appeared to be but were not in four, and were patently separated in the others. They may also be fused or separated in the Herring Gull, *Larus argentatus smithsonianus*.

*Shape.*—The shape of the adrenals varies so much in different species that it is difficult to make generalizations. They may be ovoid,

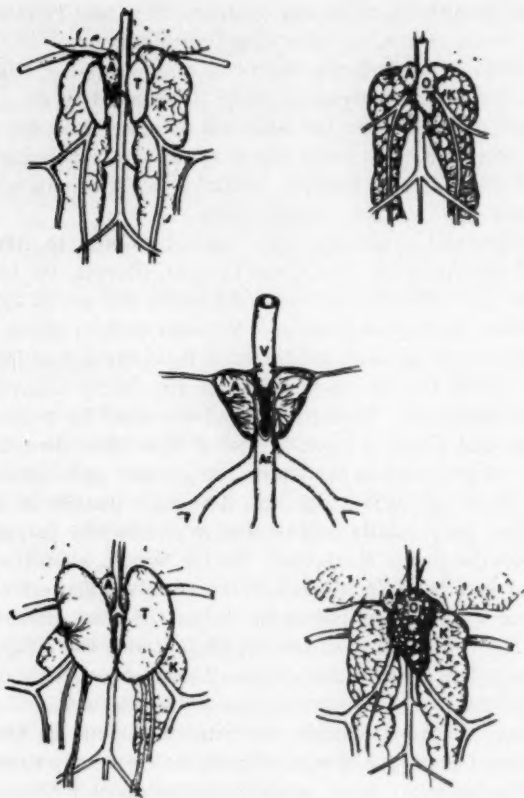


FIGURE 1.—Adrenal of domestic fowl in relation to gonads.—(Top, left) male two months old; (Right) female one month old; (Middle) dorsal aspect showing arterial openings to adrenals. (Bottom, left) male; (Right) female, both three months old. A—adrenal; T—testis; O—ovary; K—kidney; Ar—aorta; V—vein.

ellipsoid and regular, or they may be flattened, irregular bodies of variable thickness. They may be pointed at one end and the corners or edges may be attenuated. Moreover the two glands are often unlike in form (Fig. 2).

*Color.*—Usually the color is cream, yellow, or orange. It is rarely red, as is the kidney. Occasionally it is pink, gray, or dark reddish-brown. The color may be determined by the lipid present in the gland. This makes Nighthawk, *Chordeiles minor*, and Parauque, *Nyctidromus albicollis*, adrenals white, and in some water birds it



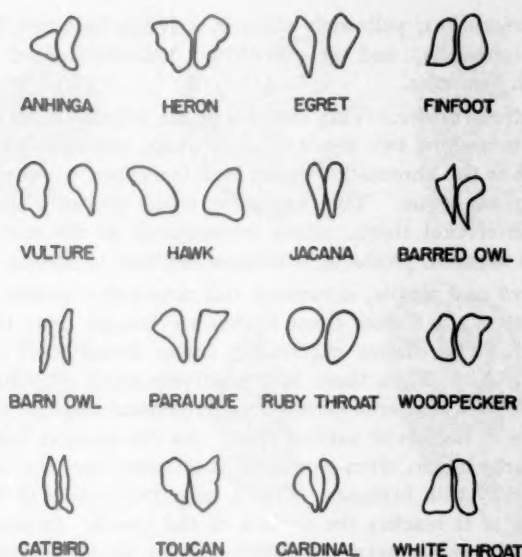


FIGURE 2.—Shapes and relative positions of adrenals: Anhinga, *Anhinga anhinga*; Agami Heron, *Agamia agami*; American Egret, *Casmerodius a. egretta*; Finfoot, *Heliornis fulica*; Black Vulture, *Coragyps atratus*; Marsh Hawk, *Circus cyaneus*; Jacana, *Jacana hypomelaena*; Barred Owl, *Strix varia*; Barn Owl, *Tyto a. pratincola*; Parauque, *Nyctidromus albigollis*; Ruby-throated Hummingbird, *Archilochus colubris*; Pileated Woodpecker, *Dryocopus pileatus*; Catbird, *Dumetella carolinensis*; Swainson's Toucan, *Ramphastos swainsoni*; Cardinal, *Richmondia cardinalis*; White-throated Sparrow, *Zonotrichia albicollis*.

makes them a brilliant orange. In the White Ibis, *Guara alba*, the body fat, as well as the adrenals, is a brilliant orange. This may be determined in some instances by the food, since the adrenal lipochrome pigment in the fowl varies in color with the food (Findlay, 1920).

Adrenal color may vary in different individuals of the same species. The following are examples of those which depart from the more common yellow to orange color. In two Bald Eagles, the adrenals were yellow in one and yellowish-pink in the other. In three Hairy Woodpeckers, they were brown in two and yellowish-white in the third. They were brown in a Red-cockaded Woodpecker, *Dendrocopos borealis*; brownish-yellow in a Phoebe, *Sayornis phoebe*; white in a Florida Blue Jay, *Cyanocitta c. cristata*; grayish brown in a Florida Jay, *Aphelocoma c. coerulescens*; brown in a Florida Crow, *Corvus brachyrhynchos pascuus*; brownish in two Black-capped Chickadees,

*Parus a. atricapillus*; yellowish-white in a White-breasted Nuthatch, *Sitta c. carolinensis*; and grayish in a Yellow-throated Warbler, *Dendroica d. dominica*.

*Microscopic structure.*—Thin sections of the adrenal fixed in Zenker-formol solution show two kinds of tissue: one, yellowish to brown in color, which is the chromaffin tissue; and the other, unstained, which is the interrenal tissue. The chromaffin tissue produces epinephrine, while the interrenal tissue, which corresponds to the cortex of the mammalian adrenal, produces hormones essential to life.

In the bird and reptile, interrenal and chromaffin tissues are intermingled, but in the former these tissues are usually more thoroughly interspersed. The darker chromaffin tissue stands out, forming a pattern (Fig. 3). When there is a relatively small amount of chromaffin tissue, it is scattered through the interrenal tissue in the form of small bodies or islands of various sizes. As the amount increases the islands become larger, often elongated, and sometimes connected with one another by thin bridges. With a large proportion of chromaffin tissue much of it reaches the surface of the gland. In some species the chromaffin tissue seems to surround the blood sinuses (Fig. 3, *Rhinoptynx* and *Sitta*).

There is similarity in pattern of the different individuals of the same species, at least in some instances, but there may be little similarity between species in the same genus (Hartman, Knouff, *et al.* 1947). Species of different genera of the same family may show considerable contrast (*Rhinoptynx* and *Ciccaba*, Fig. 3).

Of the birds studied thus far, some of those belonging to the Suborder Pelecani possess adrenals whose cells are largest and so arranged that they present a clearer picture than that found in many other groups. Adrenals of the Cormorant, *Phalacrocorax auritus*, and Brown Pelican, *Pelecanus occidentalis*, are among the best examples. Indeed they may serve as a standard for a study of other avian adrenals.

The adrenal capsule is relatively thin and if removed reveals a characteristic structure beneath, especially after fixation with hardening agents (Fig. 4, A). Sections under the microscope may show a rather orderly arrangement of interrenal cells which appear as double rows with the nuclei toward the inner contiguous ends far removed from the blood vessels which bathe the outer ends. Actually these are solid cords with the nuclei in the centers, the longitudinal sectioning making them appear as a double row (Fig. 4, B). When a cross-section is made of a cord the cells are shown to be arranged radially, the inner portions containing the nuclei being wedge-shaped. The



FIGURE 3.—Patterns of chromaffin tissue (black) in different species: *H. fulica*, *J. hypomelaena*, *A. agami*, *R. clamator*, *C. nigrolineata*, *T. curucui tenellus*, *Sitta carolinensis*, *R. satrapa*, *Seiurus noveboracensis*.

cords extend inward from the periphery and may follow a tortuous course as they approach the interior of the gland.

The islets of chromaffin tissue are few in number and small in this group of birds. The cells are more irregular than those of the interrenal tissue (Fig. 4, C). In preparation for paraffin sectioning the lipid is replaced by vacuoles. These often constitute a considerable portion of the cytoplasm of the interrenal cell. Interspersed among them are elliptical or rod-shaped mitochondria. When there is much lipid material there are fewer mitochondria and vice versa (Fig. 4, D and E). Although these bear some relation to hormone production, their function is not well understood.

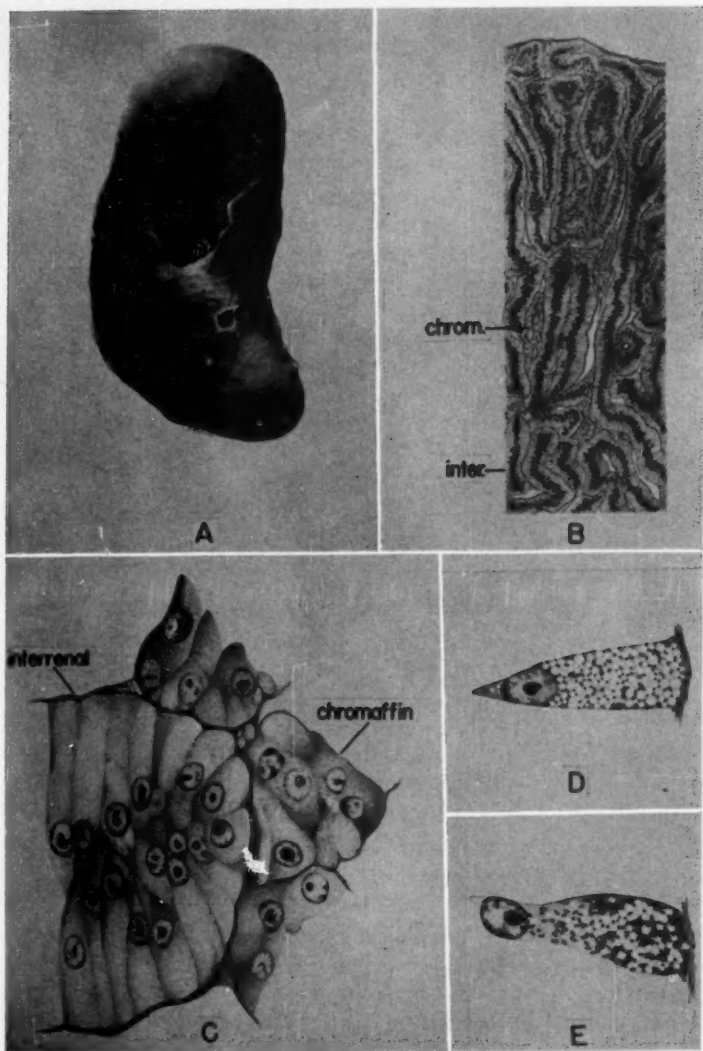


FIGURE 4.—Adrenal of Cormorant, *Phalacrocorax auritus floridanus*: A. Ext. view, capsule partially removed to show glandular structure; B. Section showing arrangement of cells; chrom.—chromaffin tissue; inter.—interrenal tissue, Zenker-formol fixation; C. Enlarged section of B. D and E, interrenal cells from the adrenal of the Brown Pelican, *Pelecanus occidentalis*: D, with large amount of lipid (vacuoles) and few mitochondria (black); E, with many mitochondria but less lipid material, fixation in Zenker-formol.

The interrenal cell of the Brown Pelican is the largest that we have seen in any vertebrate and offers the best preparation for a study of cellular changes under different conditions of activity.

From this preliminary survey we may conclude that the adrenals of certain avian groups will be very useful in the study of the relation of cellular structure to function.

#### SUMMARY

A preliminary study has been made of more than 400 species of birds, half of them from the tropics. The adrenals are located on the anterior poles of the kidneys just below the lungs and posterior to the gonads. In most species they are separate, but in a few they are fused into a single organ. The adrenals differ greatly in shape, often being irregular and varying among different individuals in the same species. Their color may be cream, yellow, or orange, but is sometimes pink, gray, or reddish brown. Microscopically the chromaffin tissue forms a pattern varying from scattered islets to an interwoven network, depending upon the amount of tissue present. The interrenal cells of certain members of the Suborder Pelecani are the largest of any vertebrate observed thus far, offering excellent material for a study of cytological changes. Because of the marked arrangement of these cells, the adrenals of this group can be used as a standard for the study of the adrenals of other birds.

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## IN MEMORIAM: ALBERT KENRICK FISHER

BY FRANCIS M. UHLER

DR. ALBERT KENRICK FISHER, a Founder and Past President of the American Ornithologists' Union and one of its best known Fellows for nearly 65 years, died in Washington, D. C. on June 12, 1948, after a brief illness from circulatory complications that developed as a result of advanced age.

With his passing, the American Ornithologists' Union has lost one of its last links with that eminent group of bird students who founded this organization in the autumn of 1883.

Dr. Fisher was born in Ossining (then called Sing Sing), New York on March 21, 1856, and thus had a life span of more than 92 years. He was the son of Hiram and Susan E. (Townsend) Fisher. His father operated an extensive mercantile business in New York City. Their home, on a beautiful hill overlooking a tidal section of the Hudson River, had spacious grounds and a surrounding countryside that undoubtedly stimulated his ardent interest in natural history. As a boy he spent much time in the tidal marshes along Croton Point, about two miles north of Ossining, and in the rugged hills of the adjacent region. While his principal interests centered around birds and plants, he also was a keen observer of mammals, reptiles, amphibians, fishes, and many kinds of invertebrates.

His early schooling was obtained at Holbrook's Military High School in Ossining. He trained for the medical profession and graduated from the College of Physicians and Surgeons of New York in the class of 1879. He then married Alwilda Merritt of Ossining. Two sons and twin daughters were born to this union. One son, Harry T., died at an early age and a daughter, Mrs. Ethel M. White, died recently. The survivors are Walter K. Fisher and Mrs. Alberta M. Marble.

Dr. Fisher was a leader in conservation movements from early manhood and a personal friend of such outstanding conservationists as Gifford Pinchot and Theodore Roosevelt.

When a college classmate and good friend, Dr. C. Hart Merriam, was appointed by the Commissioner of Agriculture to set up a Branch of Economic Ornithology in the U. S. D. A. Division of Entomology on July 1, 1885, he persuaded Dr. Fisher to give up further thought of practicing medicine and join him in founding this new Branch. They had already worked together closely for two years, along with 21 other Founders of the A. O. U., in setting up organized studies of bird



migration and geographic distribution under the sponsorship of the newly founded Union. It was upon the recommendation of the A. O. U. Council that the Commissioner of Agriculture had appointed Dr. Merriam to begin the economic studies of birds.

On July 1, 1886, through the efforts of Drs. Merriam and Fisher, this newly created Branch of the Division of Entomology was given independent status and called the "Division of Economic Ornithology and Mammalogy." The early work was largely devoted to food-habits studies and to educating farmers about birds and mammals affecting their interests, so that the destruction of useful species might be prevented. It was during this early period that Dr. Fisher prepared his monumental work on 'The Hawks and Owls of the United States in Their Relation to Agriculture,' published in 1893. This report is still considered a classic in its field. As a result of this work the destruction of harmless hawks and owls has been greatly reduced, and they are no longer threatened with extermination.

The economic studies were gradually broadened to include the various biological surveys of little-known parts of North America, and on July 1, 1905, a separate Bureau of Biological Survey was organized by virtue of a Congressional Act of March 3, 1905. Again Dr. Fisher rendered outstanding aid in furthering this expanded work.

In 1891 Dr. Fisher served as ornithologist for the famous Death Valley Expedition and prepared an extensive report on the birds observed in Death Valley and adjacent poorly known areas in California, southern Nevada, and parts of Utah and Arizona. He also took part in the Harriman Alaska Expedition in 1899 and was a member of the Pinchot South Seas Expedition in 1929. Numerous bird skins were added to the research collections of the U. S. National Museum as a result of his efforts on all these expeditions.

Dr. Fisher's ability in dealing with Members of Congress, as well as with his fellow workers, played an important part in successfully administering the broadened scope of the Bureau of Biological Survey which was later to become an important part of the present U. S. Fish and Wildlife Service. He retired in 1931, after more than 46 years of continuous effort to develop the fore-runner agencies of that Service.

In addition to the outstanding publications already mentioned, he was the author of more than 150 shorter papers dealing primarily with birds but including a number devoted to mammals, reptiles, amphibians, and various invertebrates, and biographical sketches. It is unnecessary to cite these here, because a list complete to that date was prepared by T. S. Palmer and W. L. McAtee and published on Dr. Fisher's 70th birthday, March 21, 1926, in the 'Proceedings of the

Biological Society of Washington' (Vol. 39: 21-28, 1926). A few notes, several biographical papers, a list of the birds of Plummer Island, Md., and, in collaboration with Alexander Wetmore, a report on birds of the Pinchot Expedition, appeared in later years.

Few men had a wider circle of friends in all walks of life than did Dr. Fisher. To most of them he was affectionately known as "A. K." In addition to his long connection with the A. O. U., he was a member of the following organizations: Honorary Member, American Game Protective Association and Cooper Ornithological Club; Corresponding Member, Linnaean Society of New York; as well as a member of the Nuttall Ornithological Club, the Delaware Valley Ornithological Club, the International Association of Game and Fish Commissioners, and the Washington Biologists' Field Club; Associate Member, Boone and Crocket Club, Baird Ornithological Club, and Cosmos Club.

During his last years he resided at the Cosmos Club, but for many years he lived in the Plymouth Apartments in Washington, where his "Apartment 44" became a cherished gathering spot for his close friends. He was always a genial host and an expert cook who delighted in regaling his guests with delectable sea-foods and game.

He had strong convictions on many subjects, not the least of which was a firm belief in the ill-effects of tobacco. He spread his thoughts on this subject with a missionary zeal that would have done credit to the Quaker ancestors of his mother.

Dr. Fisher was a true sportsman in the best sense of the word, a lover of dogs, rod, and gun from boyhood, but never taking any game in excess of his immediate needs.

He brought an appreciation of nature to hundreds of acquaintances and enjoyed taking them on excursions to his favorite area, Plummer Island and along the wooded shores of the Potomac River. He went regularly to this headquarters of the Washington Biologists' Field Club for more than 45 years and was active in its management and in the study of its fauna and flora. There he was widely famed as an out-of-door cook at the Club's many shad-bakes and oyster roasts. His last visit was made only a few weeks before his death, and his delight in still being able to participate in the May, 1948, shad-bake was apparent to all his friends.

He retained his keen interest in natural history and an alertness of mind that was an inspiration to all who knew him. There was no failing of memory such as is commonly associated with advanced age. He had oft expressed the wish that no formal ceremony attend his passing and requested that his remains be cremated and placed on his beloved Plummer Island amid the plants and birds that formed such an



DR. ALBERT KENRICK FISHER



important place in his life. These wishes were carried out by a small group of intimate friends.

His life has left a lasting imprint in the field of wildlife conservation. His many friends will greatly miss the kindly personality of the genial "A. K." He truly lived a complete life.

*U. S. Fish and Wildlife Service, Patuxent Research Refuge,  
Laurel, Maryland, November 9, 1950.*

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THE FOOD OF NESTLING BRONZED GRACKLES,  
*QUISCALUS QUISCULA VERSICOLOR*, IN  
CENTRAL NEW YORK

BY W. J. HAMILTON, JR.

THE food of the Bronzed Grackle has been studied by several investigators. Beal (U. S. Dept. Agric. Bull. 13: 60, 1900) reported on 2346 specimens from all parts of this bird's range. Of the specimens examined, 456 (19.1 per cent) were nestlings. Beal's study indicated that the food of young grackles often differed materially from that of the adults. The food of the entire year, taking into account all 2346 stomachs, adult and young, was made up of 30.3 per cent animal and 69.7 per cent vegetable matter. Of the total examined by Beal, 28 specimens taken in May and June are reported from New York, but there is no indication if any of these were nestlings. Warren ('Birds of Pennsylvania,' pp. 221-222, 1890) stated that the diet of the young birds, while under parental care, is almost exclusively insects, consisting mainly of caterpillars and grubs. This large blackbird, with its formidable bill, has been praised and cursed alike by those who farm the land. Few exact data on the food of this common and widespread species have been recorded. This report is a minor attempt to provide data on the dietary of the nestlings in a restricted locality.

To determine the dietary of nestling Bronzed Grackles in the Ithaca, New York region, collections of young in the nest were made in May and June of 1947, 1948, and 1949. A few nestlings were collected in May, 1926, and analyses made of their food at that time. These analyses do not differ materially from the observations recorded in later years. One hundred and thirty young birds have been examined. The droppings of nestlings at various ages were likewise collected. Feces can be collected merely by handling the young or stroking their abdomens. Droppings deposited in this manner were

placed in small match boxes while at the nest site and examined within a few hours after collecting.

The Bronzed Grackle is an adaptable bird in central New York, nesting in a variety of situations in the same locality. These birds occasionally build their nests in dead cat-tail stalks in the same habitat chosen by Red-winged Blackbirds, *Agelaius p. phoeniceus*. They also build 30 or more feet high in a grape tangle or willow a few rods from the swamp border. On higher ground Norway spruce are favored, the birds resorting to the same sites in farmyards and cemeteries year after year. One particularly good collecting area was a thick stand of red pine bordering a cemetery. In this site, ten nests were observed in an area of half an acre. At the foot of Cayuga Lake at Ithaca, New York, a stand of 20 Norway spruce, covering an area of 1630 square feet, contained seven grackle nests in 1947 and six nests each in 1948 and 1949. In these same spruces Mourning Doves, *Zenaidura macroura carolinensis*, and Green Herons, *Butorides v. virescens*, nested, often within a few feet of the nesting site of the grackles.

Many of the nests were situated close to the inlet of Cayuga Lake. Most of the nests from which nestlings were observed were near ponds, lakes or other watercourses. Observation indicated that the adults often flew a half-mile to secure food for the nestlings, although the same food might have been obtained within a few feet of the nest. When alewives, *Pomolobus pseudoharengus*, were dying in great numbers and their bodies being washed to the shore within a few feet of one nest, the birds were observed to fly a third of a mile to collect these dead fish which were fed to the young. In a grove of red pines in which the birds nested, the adults also flew an airline distance of a third of a mile to the ponds at the Cornell Fish Hatchery, where tadpoles of *Rana clamitans* were captured and fed to the nestlings. When one considers the various food items that the nestlings are known to eat, and considers the proximity of these items to the nest, observation suggests that some predilection may be exercised by the adults. On the other hand, the ease of capture may indicate a farther flight for food than might appear necessary. Adults flew nearly a third of a mile to collect red-backed salamanders, *Plethodon cinereus*, which were fed the young, although a sizable acreage of lawn, harboring earthworms and an abundance of insects, was within a few feet of the nesting site.

Presumably, availability of food items plays a major rôle in the dietary of young grackles. The data suggest, however, that the ease of capture of certain large items may induce longer trips from the nesting site. Contrariwise, the adults pass over feeding grounds that



presumably provide adequate food for the young. The birds' purpose in flying relatively long distances for food items, many of which are close at hand, is not known.

Usually similar food was fed a complement of nestlings at one time. Repeated observations of individual broods indicated the same kind of food. This fact was further substantiated through analyses of droppings from the nestlings.

Animal remains were found in every nestling, the bulk comprising 89.1 per cent of the total volume. Plant material was taken from 26.1 per cent of the stomachs, constituting 6.4 per cent of the volume. The remaining matter was inorganic, consisting of small grit, gravel, and other mineral fragments. Sizable fragments of cinders from a nearby railroad bed, large pebbles, and miscellaneous grit indicate that this species feeds its young material that may aid in digestion.

Sex of the young was positively determined on 92 individuals. Of these, 49 were males, 43 females.

#### DISCUSSION

*Insects.*—Insects are the predominant food of nestlings. Beetles appear to be of greatest importance, constituting, in frequency, 42.5 per cent of all insects eaten. Adult June beetles, *Lachnosterna*, were fed the larger nestlings in some numbers. In May, 1949, a greater number were fed to the nestlings; this correlated with the increase in numbers of this scarabid in that year. Fewer were taken in 1948, a year of lesser abundance for *Lachnosterna* in the area studied. Carabids, elaterid larvae, and fragmentary remnants of small unidentified scarabids comprised the remaining beetles. Lepidopterous larvae totaled 40.3 per cent of the bulk and occurred in 52.4 per cent of the

TABLE 1  
FOOD OF 130 NESTLING BRONZED GRACKLES IN THE ITHACA, NEW YORK  
REGION, MAY AND JUNE, 1947-1949

Food	Per cent occurrence	Per cent by bulk
Insects	84.6	48.2
Earthworms	18.5	10.9
Amphibians	10.8	8.3
Fish	70.8	6.6
Spiders	24.6	5.4
Green grass	9.2	3.2
Millipedes	6.1	0.8
Grain	4.6	1.4
Sowbugs	4.6	3.4
Fruit	4.6	1.8
Mammals	1.5	0.3
Molluscs	2.3	5.2
Grit	17.0	4.3

nestlings which had been fed insects. Of these, a relatively small percentage were determined as cutworms. Hemiptera were present in 16.7 per cent of the young which had been fed insects. These bugs consisted principally of pentatomids. The head capsule, in some numbers, remained after the other parts had been digested. Possibly the adults seek out these small hemipterans. At any rate the head capsules occurred repeatedly in the stomachs of nestlings in successive years. A few ants, *Lasius niger* and *Formica* sp., a single Mecoptera, *Panorpa* sp., and the remains of a grasshopper, *Melanoplus* sp., constituted the remaining insects. The grasshopper was undoubtedly a dead specimen, gleaned from the tussocks of dead grass which partially conceal these orthopterans during the colder months.

*Earthworms.*—Evidence that the worm is killed, broken into pieces, and then fed the young was indicated by the fragments removed from the throat of nestlings a few seconds after being fed. Digestion is absolute, no indication was found of this item in the droppings. A careful search for the setae produced negative results.

*Amphibians.*—The relatively high percentage of salamanders and tadpoles does not suggest availability so much as the possible ease of capture. Grackles nested within a few feet of a stream in which tadpoles of *Rana clamitans* occurred. These tadpoles were frequently seen in water shallow enough to provide easy feeding for the grackles. The adults flew to a gorge a third of a mile distant to take salamanders,

TABLE 2  
FOOD OF 26 NESTLING BRONZED GRACKLES (RECENTLY HATCHED TO THREE DAYS OLD) COLLECTED AT ITHACA, NEW YORK, MAY-JUNE, 1947-1949

Food	Per cent frequency	Per cent bulk
Insects	88.5	52.3
Spiders	65.4	15.7
Earthworms	26.9	11.6
Sowbugs	15.4	8.2
Fish	15.4	3.7
Molluscs	11.5	3.8
Grass	7.7	2.2
Grain	7.7	0.8
Fruit	3.8	0.7
Grit	3.8	0.9

*Plethodon cinereus* and *Desmognathus fuscus*, to feed their nestling young. One well feathered nestling had been fed three *Plethodon cinereus*. On May 13, 1948, and May 15, 1949, nestlings in the same colony (Norway spruce at the foot of Cayuga Lake) had been fed red-backed salamanders. Presumably some birds become conditioned to favored feeding grounds. The parent birds may learn the method of capture and take certain food in areas which are accessible and pro-

vide easy capture of the particular item. Tadpoles of *Rana clamitans* were the only anurans fed to the nestlings which I examined.

*Fish.*—A considerable number of nests under observation were close to Cayuga Lake and its inlet. At the time of this study, alewives, *Pomolobus pseudoharengus*, were dying in great numbers. These fish were washed to the shore, often in considerable numbers. Adult birds were frequently observed feeding on the smaller fish or tearing up the partly decomposed bodies of the larger individuals. Within a few feet of one grackle nest, the dying fish were extremely abundant. Rather than take this easily available food, the adults flew along the lake shore for nearly half a mile to secure the same beached food which was fed the nestlings. A single pharyngeal arch of a cyprinid was recovered from the gizzard of a large nestling.

*Spiders.*—Spiders were most frequently fed to the smaller nestlings, newly hatched to approximately four days of age. The following genera were identified: *Tibellus*, *Mimetus*, *Tetragnatha*, and *Pardosa*. Often a dozen or more small spiders were found in a single gizzard. Newly hatched Crows, *Corvus b. brachyrhynchos*, which I have examined often contain a relatively large number of small spiders.

*Green Grass.*—The presence of considerable amounts of green grass in the gizzards of several nestlings suggests that this item is not adventitious. Occurring in nine per cent of the nestlings, its presence suggests that adult birds deliberately feed the nestlings fragments of grasses and other green succulents.

*Other Food.*—The remaining items were represented in small quantity. Millipedes, *Julus* sp., were fed the young sparingly. Some waste grain, a few seeds of fruit, including a *Rubus* seed from the past season, sowbugs (Oniscidae), and molluscs were recovered from a few gizzards. The snails include *Anguispira alternata* and *Cochlicopa lubrica*. One nestling, estimated as being six days of age, had been fed part of a newborn field mouse, *Microtus pennsylvanicus*. Another large fledgling contained fragments of a small sorcid, probably *Sorex cinereus*.

Cornell University, Ithaca, New York, October 3, 1950.

SOME OBSERVATIONS ON THE FALL MIGRATION  
AT DRY TORTUGAS, FLORIDA

BY ALEXANDER SPRUNT, JR.

THE Dry Tortugas Keys present tremendously interesting avian features aside from sea-birds. In spring and fall, these "rocky islets" of Ponce de Leon exhibit a passing pageantry of land species which is no less remarkable than thrilling to the fortunate observer.

Strategic as these keys are in their location across the migratory lanes, little actual work has been done with land birds since the discovery of the keys in 1615. A great deal has been accomplished in regard to the summer tern colonies; the neglected periods are spring and fall, those seasons which witness birds at Tortugas which occur at no other times. To some extent this is understandable. Sixty-eight miles due west of Key West, the Tortugas are hard to reach; the trip normally entails considerable expense and the risk of seasickness!

The writer has been privileged to make the trip eight times, but on none of them except the last has he been there during the fall migration. The time was short and the season was somewhat early but these handicaps were unavoidable. Hardly since the days of W. E. D. Scott, in 1890, has any record of fall movements of land birds been made. In view of the recent keen interest in the question of whether birds cross the Gulf of Mexico, or largely skirt the edges, it seems that detailed study at Tortugas is highly desirable. These notes are but a start. As usual, the writer's trip (September 2-9, 1949) was made possible through the cordial co-operation of the National Park Service and its capable personnel of the Fort Jefferson National Monument.

Practically every daylight hour was utilized. While the total list secured may not seem impressive, some of the *negative* observations would appear to possess almost as much interest as the actual instances of occurrence. They certainly open questions needing more study. Study in mid-September to mid-October would reveal a great deal, being the crux of the autumnal movement. That has, as yet, never been done by anyone.

No particular technique was employed. None is needed. Garden Key, on which Fort Jefferson stands, is practically covered by that structure. The entire key comprises some seven acres and the Fort occupies five. The latter is a six-sided pile of masonry, enclosing an open parade ground where most migrants feed during the day. This is covered with grass, kept mowed, and studded here and there with characteristic trees and shrubs. These are few, and it is easy to see

any bird which may visit the area; indeed, it is safe to say that one need hardly miss an individual. Aside from working at ground level, the observer is greatly helped by being able to use the second gallery of the Fort, as well as the parapet, giving elevations of about 20 and 40 feet, respectively. Thus, one can look down on birds, as well as up at them.

The day's work simply consisted of getting up at, or before, sunrise and making rounds of the area throughout the rest of daylight. In all of this, the writer was ably assisted by his son, and to lesser extent by his wife. It was hoped that it might be possible, by stationing oneself on top of the Fort in early morning, actually to witness arriving flights of birds, coming in over the Gulf. The attempt was made but with rather indifferent success. Unless a mass movement had been detected, the difficulties are enhanced by the immensities of sea and sky. To catch individuals, or even small groups, is far more difficult than one would imagine. None-the-less, some small success was had, for twice groups of Bobolinks came in, high overhead, to pitch down into the parade; twice, Eastern Kingbirds were seen to do this, and once, a Great Blue Heron.

Close attention was paid to the *physical condition* of all small birds. No examples of real exhaustion were noted (other than the case of the Bridled Tern), and there were few instances in which any bird seemed obviously "tired." In one, this was definitely the case. However, *tamelessness* of all birds was very marked. Approach could be made to very close ranges, but the majority of the birds were perfectly active and busy with feeding. All seemed to be in good plumage condition. Even the "very tired" cuckoo, despite its lethargy, was trim and neat. In this connection, certain remarks of Dr. Paul Bartsch seem worth noting. In his paper 'The Bird Rookeries of the Tortugas' (Smiths. Rept. 1917, Publ. 2512, 1919) he states that:

"The Tortugas are used as a stepping-stone by many of the lesser migratory birds that winter in the West Indies and even farther south. In the northward journey in spring and the southward flight in autumn, these birds rest here for a varying length of time . . . These migratory land birds always show the effect of their stay on these keys, for most of them look entirely different from the trim little creatures which we are accustomed to see on the mainland. The little warblers and even the bobolinks are all fluffed up and ragged and their appearance and motion suggest 'the dim gray dawn of the morning after,' the after effect of a 'night out.' They are lacking in shyness and appear quite as careless about their safety as they do about their appearance."

It so happens that my experience was completely at variance with this, other than in the phase of shyness. In no single case was any bird "ragged," but what the conditions may be at the height of the



migratory movement, with bad weather, many more birds, etc., I cannot say. Bartsch's remarks are no doubt based on many more specimens than we encountered.

Regarding weather, we were both fortunate and otherwise. Bad weather is desirable; we had little of it. Though our arrival was on the heels of the hurricane which devastated parts of Florida on the night of August 26-27, no effect was noticeable at Tortugas. However, on September 3, 4, and 5, squally conditions prevailed, with intermittent sunshine. On the morning of the third, a southwest wind reached a maximum of 44 miles per hour. It blew from that quarter the next two days, then veered to the north and northeast, diminishing to gentleness. The first few days then saw the greatest number of birds. The last three showed little movement, but new species arrived every day. Temperatures remained almost constant, the highs reaching 86° F. at 2 p. m. Birds came in both with, and against, the wind.

Having spent a day and a half in the Upper Keys prior to proceeding to Tortugas, we were able to draw some interesting comparisons between those islands and conditions at Fort Jefferson. Great numbers of Gray Kingbirds were, for instance, congregating on the Keys, accompanied by Eastern Kingbirds. We did not see a single Gray Kingbird at Tortugas, though the Eastern was seen every day and in some numbers. Nighthawks were passing through the Keys in abundance; we saw none at Tortugas. On the return trip, a stop was made at Tavernier (Key Largo) and I compared conditions with my colleague Robert P. Allen who lives there. He had noted multitudes of Gray Kingbirds and Nighthawks to our none. Conversely, we had, at Tortugas, Ovenbirds, Waterthrushes, and Parula, Hooded, and Cape May Warblers, while he had seen none.

In considering any trans-Gulf movement involving Tortugas, some idea of distances should be noted. It is possible that the area is used as freely by coastwise migrants as by those which cut right across the open Gulf. Which may be in the majority is a question. The following distances were worked out on charts by Mr. John R. DeWeese, Custodian of Fort Jefferson.

Tortugas to Havana, Cuba.....	105 miles SE
Tortugas to Cape San Antonio, Cuba.....	205 miles SW
Tortugas to Yucatan.....	365 miles SW
Tortugas to Cape San Blas, Florida.....	320 miles
Mouth Miss. River to Yucatan.....	480 miles S
Port Arthur, Texas, to Carmen, Mexico.....	665 miles S
Width of Yucatan Channel.....	110 miles



Other things being equal, one would suppose that a natural route for many birds leaving the northern Florida Gulf coast would be from Cape San Blas, in the Apalachicola area, across Tortugas for Cuba. The former would be the only land encountered, entailing a flight of 320 miles. It would also seem that any birds leaving the Pensacola-Mobile-Mississippi River mouth would travel straight south, with landfall at Yucatan, 480 miles away. Though this would miss Tortugas considerably to the westward, some birds may be driven off such course by adverse weather, and so reach Tortugas. Indications are that this does occur. The case of the Yellow-throated Warblers is one in point. (See notes under this species in list below.) Instances involving the appearances of Western Willet and Grinnell's Waterthrush may be others. A great obstacle in drawing conclusions is lack of data.

One more or less constant source of specimens could be the light-house on Loggerhead Key. The personnel there have wonderful opportunities for collection, but none of them know or have any interest in the birds. Something of a start has been made however, by securing their promise to deposit specimens found in future in formalin bottles provided them. The possibilities seem infinite.

Some mention must be made of the Tortugas vegetation where migrants rest and feed. Garden Key is where most of them are seen, although it is not anything like as heavily grown as is Bush Key where the Sooty-Noddy Tern colonies are situated. Loggerhead Key has many so-called Australian pines, *Casuarina*, and Coconut Palm, *Cocos nucifera*, but little else. Hospital (Sand) Key has nothing except four patches of *Salicornia*; Middle Key has not a sprig of anything, and East Key has much grass such as Sea-oats, *Uniola*, Goat's-foot Morning Glory, *Ipomaea pes-capra*, and some Bay Cedar, *Suriana*. Long Key is no more than a reef, awash much of the time.

The parade ground of Fort Jefferson is, therefore, much the best observatory. The trees there are mainly Buttonwoods and Gumbo-limbo, with a few others. Among these, the Portia, *Thespesia populnea*, Tamarind, *Tamarindus indica*, and Oleander, *Nerium oleander*, may be mentioned. There is much activity in the buttonwoods, and the small, roofless powder magazine in the southwest corner of the parade is thickly grown in bushes and small trees and harbors many birds. As many as 11 species of warblers occur at Tortugas and were noted in the first week of September.

Following, in brief annotated form, is the list of birds observed.

## WATER BIRDS

1. BROWN PELICAN, *Pelecanus occidentalis*.—Adults and immatures seen daily; maximum number occurred on 5th, when 23 were counted.
2. BLUE-FACED BOOBY, *Sula dactylatra*.—Seen daily; frequents buoys and channel markers between Garden and Loggerhead Keys. Two pairs usually stay throughout summer but on 5th we saw five individuals.
3. WHITE-BELLIED BOOBY, *Sula leucogaster*.—Seen daily. Usually frequent buoys of channel between Garden and Bush Keys; sometimes on north coal docks and Bush Key and occasionally on pilings west of south coal docks. Half a dozen adults and immatures present (total).
4. FRIGATE-BIRD, *Fregata magnificens*.—About 200 present. Roosted and rested on Bush Key. Often soared over Fort and lagoon anchorage. One hundred and twelve were counted on Bush Key on 8th, with 12 more soaring over lagoon, others at distance. Males with *fully distended pouches* were seen twice on 4th, once on 8th, in flight.
5. GREAT BLUE HERON, *Ardea herodias*.—One immature seen several times during week, usually at south coal dock and beach. One bird came in over Gulf, high up, from north in afternoon of 8th, circled twice over Bush Key, flew off to south, then wheeled beyond Long Key Reef, came back, and landed on Bush Key.
6. LITTLE BLUE HERON, *Florida caerulea*.—Two immatures seen on Bush Key on 4th. Saw same two, presumably, on Long Key Reef on afternoon of 8th.
7. EASTERN GREEN HERON, *Butorides virescens*.—One seen on Loggerhead Key in casuarinas at old Carnegie Marine Laboratory site.
8. YELLOW-CROWNED NIGHT HERON, *Nyctanassa violacea*.—An immature seen several times about Fort. This bird would sit for long periods in same spot.
9. PIPING PLOVER, *Charadrius melodus*.—One individual seen on beach by dock on 5th. Allowed very close approach.
10. BLACK-BELLIED PLOVER, *Squatarola squatarola*.—Seen daily on beach strips and moat wall. Some specimens showed marked remains of summer plumage. Heard several times at night over parade ground.
11. RUDDY TURNSTONE, *Arenaria interpres*.—Seen daily on beach strips, moat walls and coal dock ruins. Maximum was eight at one time on the 3rd. Some showed marked traces of summer plumage, but majority were in winter dress.
12. SPOTTED SANDPIPER, *Actitis macularia*.—Several seen along beach and about coal docks. One to three daily, though there may have been some duplication.
13. SOLITARY SANDPIPER, *Tringa solitaria*.—Seen every day. Very tame, more so than any of the shore-birds noted.
14. EASTERN WILLET, *Catoptrophorus s. semipalmatus*.—One seen on the 3rd near dock was referable to this species.
15. WESTERN WILLET, *C. s. inornatus*.—Two birds seen on 5th are referred to this race. They were very pale, no apparent streakings beneath and bills noticeably long, seemingly markedly so. Approach was made to very close range, and the birds watched carefully from Fort casemates with 9x glasses.
16. LEAST SANDPIPER, *Erolia minutilla*.—Flock of four seen at Pond 2 on Bush Key on the 4th at a range of a few yards—yellow-greenish legs very obvious.
17. SEMIPALMATED SANDPIPER, *Ereunetes pusillus*.—Several seen on beach near dock at high water mark, feeding in sea-weed drift.

18. SANDERLING, *Crocethia alba*.—Five seen on 5th near dock; one on the beach at Loggerhead Key also. All in winter plumage.

19. COMMON TERN, *Sterna hirundo*.—Seen several times over lagoon and beaches of Bush Key.

20. SOOTY TERN, *Sterna fuscata*.—Still present in great numbers, but diminished about 25 per cent from nesting total (J. R. DeWeese). Many young unable to fly as yet. Swarms of birds in air at all hours. Noise from Bush Key not as pronounced as at nesting season but still prevalent throughout day and night.

21. BRIDLED TERN, *Sterna anaethetus*.—One found in casemate of second gallery of Fort on afternoon of 7th. In exhausted and sick condition, head drooping, and eyes closed. Picked up by writer and found to be practically skin and bones. It was in immature plumage, a phase unfamiliar to the writer. Skin made of specimen and referred to Alexander Wetmore who corroborated identification. A. H. Howell (1932) lists only two specimens taken in Florida, one of which is in British Museum. The other was presented by Audubon to Lawrence, and examined by Coues (1874). The stomach was empty.

22. ROYAL TERN, *Thalasseus maximus*.—Seen every day, but in no great numbers.

23. CASPIAN TERN, *Hydroprogne caspia*.—Seen on 3rd over Bush Key Channel and once or twice afterward.

24. BLACK TERN, *Chlidonias niger*.—Two or three seen on 4th over lagoon in front of dock.

25. NODDY, *Anous stolidus*.—Still present in numbers, many immatures. The writer counted 143 birds at one time, and 156 at another, sitting on rusting steel beams of north coal dock, always a favorite resting perch. On a trip to Hospital Key on 6th, by outboard skiff, Noddies came so close that it was possible to seize them in air. They exhibit this trait to a marked degree.

#### LAND BIRDS

26. BLACK-BILLED CUCKOO, *Coccyzus erythrophthalmus*.—One seen on 4th at 8 a. m., in the small powder magazine. The bird was "very tired" but appeared to be in good condition and plumage. It sat perfectly motionless for as long as the writer cared to look at it. First seen outside magazine, it flew from tamarind tree into structure, where the writer followed it and watched it. It did not object to approach to within ten feet.

27. BELTED KINGFISHER, *Megasceryle alcyon*.—This species seen several times about moat and dock. There were at least two present at a time. On early morning of 6th, watched two take off from Fort and fly straight southwest. After about a mile one of them turned back. The other adhered to the southwest course.

28. EASTERN KINGBIRD, *Tyrannus tyrannus*.—Seen every day. Five present on the morning of 3rd; four on 4th; four on 5th; 17 on 6th; 12 on 7th; eight on 8th.

The flight of 17 came in from north at 7:35 a. m. on 6th. They pitched down into parade ground. Kingbirds constantly frequented topmost twigs of portia trees, probably because many of these were dead and reached up above lower leafy ones. They would sit for long periods without moving, or feeding.

29. WOOD PECKER, *Contopus virens*.—One seen in buttonwoods in parade about 8 a. m. on 3rd. Another was seen later in morning, but I cannot be certain whether there were two, or a duplication. This bird allowed very close approach.

30. BANK SWALLOW, *Riparia riparia*.—This swallow came on 7th and 8th. Never more than three or four, but stayed all day. The parapet of the Fort was an ideal spot to watch them, often they passed within a few feet.

31. BARN SWALLOW, *Hirundo rustica*.—Present in some numbers every day. The behavior of these familiar birds at Tortugas was unlike anything the writer had witnessed before. They would follow motor lawn-mower, as well as anyone walking across parade, and swoop and circle for insects disturbed in short grass. Often, they would fly between persons walking no more than two feet apart. Snapping of the bills could be heard plainly. Flight was about ankle high. They were active up until actual darkness, flying up and down over moat close by casemates. On frequent occasions birds were on ground for considerable periods.

32. PURPLE MARTIN, *Progne subis*.—Seen only on 7th and 8th. On 7th, an immature sat on radio aerial over Sallyport of Fort and preened for quite a while. It finally left, flew out over lagoon where it was joined by another, and the two circled and swooped among Sooty Terns soaring there. After a few minutes of this, both took off to the southwest. Three on morning of the 8th.

33. BLUE-GRAY GNATCATCHER, *Poliophtila caerulea*.—Seen first on 5th on Loggerhead Key. Also on Garden Key (Fort Jefferson) on 6th and 7th. Never but one at a time. Very active.

34. BLACK-WHISKERED VIREO, *Vireo altiloquus barbatulus*.—Seen in buttonwoods on parade ground on 4th, 5th, 6th, and 7th. Usually one at a time, though on 5th there appeared to be two. Easy approach to within a few feet. The whisker mark obvious in all cases.

35. RED-EYED VIREO, *Vireo olivaceus*.—One seen on 6th in buttonwoods in parade.

36. BLACK AND WHITE WARBLER, *Mniotilta varia*.—Seen every day but 8th. As many as three or four at a time. There were four on 3rd; all in good condition and active.

37. PROTHONOTARY WARBLER, *Protonotaria citrea*.—Seen only on 6th. Several males, females, and immatures present at very close range on small powder magazine and buttonwood trees.

38. SWAINSON'S WARBLER, *Limnethlypis swainsonii*.—One seen on 4th, at very close range in portia tree in parade, at 10:30 a. m. Very deliberate in movements. Remained in tree for 15 minutes and was often within 15 feet.

Another seen on 5th in small powder magazine, perched near ground, and also apparently tired. Excellent observation of both.

Howell (1932) lists this warbler as having been taken on Tortugas in 1890.

39. WORM-EATING WARBLER, *Helmitheros vermivorus*.—Two seen on 6th. One was in high buttonwoods near lighthouse bastion; another about small powder magazine. Both in excellent plumage and condition and showed no signs of fatigue.

40. PARULA WARBLER, *Parula americana*.—Seen every day. This, with Redstarts and Oven-birds, was most frequent warbler, possibly excepting Prairie. None appeared tired. Paid little attention to observers; some seen within a few feet.

41. YELLOW WARBLER, *Dendroica petechia*.—One fine male seen on 8th. Fed in buttonwoods near lighthouse bastion and frequently on ground in short grass. No signs of fatigue. This was one of quietest days during week, gentle north breeze, 86° temperature, bright sun.

42. CAPE MAY WARBLER, *Dendroica tigrina*.—Several seen on 6th; a lesser number on 7th. In fine plumage, rather active. Also fed on ground a good deal.

43. BLACK-THROATED BLUE WARBLER, *Dendroica caerulescens*.—Seen every day; as many as 10 or 12 at Fort during one day. Females predominated, only three or

four males being found. Very often fed amid short grass on ground, frequently flew into casemates of Fort on ground floor.

44. YELLOW-THROATED SYCAMORE (?) WARBLER, *Dendroica dominica (albilora ?)*.—This an interesting case. Seen every day but 8th, and at times as many as three or four birds at a time, the writer was struck at sight of the first one (Sept. 2) because of the eye-stripe. It was pure white, without a tinge of color. This proved to be the case with every specimen seen during the week!

These warblers were very tame, all in good plumage, deliberate, but always moving, and coming to within a few feet frequently. Attention of both his wife and son was asked by the writer regarding the eye-stripe, and both of them saw clearly that, in every case, it was pure white. *Albilora* is mainly a Mississippi Valley bird and its presence at Tortugas in fall surely indicates a migratory movement in a trans-Gulf sense. One bird was seen on Loggerhead Key on the 5th. It was same as others.

45. PRAIRIE WARBLER, *Dendroica discolor*.—One of commonest species seen—several every day and as many as a dozen were on the parade at once. A few were seen in bushes on outside of the Fort, across moat; no other warbler occurred there. All active; all in good plumage.

46. PALM WARBLER, *Dendroica palmarum*.—One seen on the 3rd in small powder magazine.

47. OVEN-BIRD, *Seiurus aurocapillus*.—One of commonest of all migrants every day. 10 to 12, or more were present continually except on the 8th, when the numbers dropped sharply. Seen almost anywhere inside the Fort and parade, often in the galleries and casemates. Allowed very close approach but none appeared worn or feeble.

48. NORTHERN WATER-THRUSH, *Seiurus noveboracensis*.—Seen almost every day—frequented casemates of Fort, catching insects about galleries. In small powder magazine often. Easy to watch at close range. As many as 15 present from 3rd through 6th. Dropped off on 7th and 8th.

49. GRINNELL'S WATER-THRUSH, *Seiurus noveboracensis notabilis*.—One seen in small powder magazine on 6th. This bird was "tired," sat quietly for a long while close to ground in thicket growth, but at close range. Eye-line was neither white nor buff, but in between; throat was definitely marked with fine dark flecks.

50. LOUISIANA WATER-THRUSH, *Seiurus motacilla*.—One seen on ground at very close range under large oleander bush at north end of old officers' quarters. Eye-stripe was pure white and the throat unspotted.

51. YELLOW-THROAT, *Geothlypis trichas*.—Only one specimen seen, this being under oleander bush at same time the Louisiana Water-thrush was observed.

52. HOODED WARBLER, *Wilsonia citrina*.—Seen first on 4th, when female was watched in small powder magazine. Males appeared next day. This spot was favorite haunt for them, one or two being seen on 6th, 7th, and 8th.

53. AMERICAN REDSTART, *Setophaga ruticilla*.—Commonest warbler seen, in numbers every day. In evidence too, throughout each day, as they fed freely on ground in open, as well as in galleries of Fort. The incessant tail and wing spreading was often the only movement seen in trees. Females and immatures largely predominated, only three full-plumaged males were seen against dozens of others.

54. BOBOLINK, *Dolichonyx oryzivorus*.—First seen on 3rd, when five came in from east, high up, at 10:15 a. m. These came down into parade. On 4th, at 6:20 a. m.,

three came in from northeast, pitched down into bushes outside Fort, near north coal dock. Saw one of these (?) later in the morning, in a dead bay cedar on west beach. None appeared excessively tired.

55. SUMMER TANAGER, *Piranga rubra*.—On morning of 7th, about 10 a. m., my son was on south parapet of Fort and called to me down in parade to watch for a bird in the high buttonwood near the sallyport. I located it almost at once, a female of this species. It was obviously "weary." Sat for almost a half hour on one of top branches of tree, perfectly motionless. This was a quiet day with gentle breeze from northeast.

National Audubon Society, Charleston, South Carolina, July 11, 1950.



## NOTES ON DISTRIBUTION OF NORTH PACIFIC ALBATROSSES

BY DANIEL Q. THOMPSON

THERE is comparatively little detailed information available on the seasonal distribution of North Pacific albatrosses. Miller (1936, 1940, and 1942) contributed observations from cruises in waters offshore from Southern California, Yocom (1947) reported notes on Black-footed Albatross from four oceanic stations in the North Pacific, and Arnold (1948) contributed notes from Aleutian waters. The following refers to a far more extensive area than do those cited above and represents day-to-day observations through 45,000 nautical miles cruised between January 24, 1945, and December 2, 1945. Approximately half of this mileage was cruised between the Pacific Coast of the United States and the Hawaiian Island Chain; the remaining mileage was spread over the Central and Western Pacific, reaching a southwestern limit at the New Hebrides and extending northwest to Okinawa. Of the total, approximately 5,000 miles were logged below the equator and hence were far south of the normal range of all three North Pacific albatrosses.

While under way, an average of four hours was spent on bridge watch during each daylight period; an alert lookout was maintained in all sectors during these periods. Several trips were also made to the stern each day and observations recorded on birds attracted to the ship's wake. Marine binoculars (7 by 50) were used in all observations.

At the end of the war, the ship's logbooks were reviewed; positions, soundings, sea-water temperatures, and local weather data thus became available for comparison with the daily bird notes.

A total of 352 Black-footed Albatrosses, *Diomedea nigripes*, were seen during 1945; of these only ten individuals were seen west of Oahu, T. H. On the same runs ten Laysan Albatrosses, *Diomedea immutabilis*, were observed, four of which were west of Oahu. No Short-tailed Albatrosses, *Diomedea albatrus*, were encountered during the entire year. Thus the greater part of these notes deals with Black-footed Albatrosses observed between the Pacific Coast of the United States and the Hawaiian Chain. This portion of the data is presented in graphic form. The remaining notes are insufficient for graphic presentation.

*Acknowledgments.*—Grateful acknowledgment is extended to Dr. Joseph J. Hickey, Department of Wildlife Management, University of Wisconsin, for guidance in the preparation of this manuscript.

I am also indebted to Dr. William H. Elder, Department of Zoology, University of Missouri, for helpful suggestions in the arrangement of this paper.

#### BLACK-FOOTED ALBATROSS

Black-footed Albatrosses habitually followed the ship for hours during daylight, evidently foraging for garbage scraps. This scavenging habit was often observed after meal hours when garbage was dumped over the stern. A dozen or so birds then gliding over the wake would quickly settle in the turbulent water and drift astern with the refuse. Meat scraps were the preferred food. It is possible that these albatrosses were also attracted by natural food churned up in the ship's wake. On two occasions they were observed scaling close astern on bright, moonlight nights.

When Black-footed Albatrosses were numerous, it was impossible to keep a count of individual birds; therefore, it was thought best to record the maximum number seen at any time during the day. These counts then are minimum daily figures because no attempt was made to account for stragglers or replacements.

Ten crossings (5 round trips) between the Pacific Coast of the United States and the Hawaiian Chain are graphed in Figure 1. Sea temperatures ranged from 9° to 30° C.; albatross counts varied from zero to 45. For comparison it is thus convenient to plot these separate quantities on a common numerical scale. Note again that the curve for Black-footed Albatrosses does not represent the total number of birds seen each day but rather is the maximum number of birds counted astern at any one time during the day.

From these data it would seem that Black-footed Albatrosses tend to concentrate over the cold waters of the California Current during all seasons of the year. These birds are probably attracted by an abundant natural food supply stemming from the relatively rich biota of these low-temperature waters. The continued presence of numbers of Black-footed Albatrosses along the North American continental shelf during their breeding season (beginning in late October on the northwestern part of the Hawaiian Chain) indicates a substantial non-breeding population.

Using longitudes 155, 145, 135 and 125 West as class midpoints, the seasonal data from the ten crossings or transects graphed above are summarized for each ten degree span of longitude as follows:

<i>Longitude</i>	<i>155 W.</i>	<i>145 W.</i>	<i>135 W.</i>	<i>125 W.</i>
Black-footed Albatrosses	1.0	2.7	7.5	13.8
Sea Temperatures	27.7° C.	21.6° C.	18.5° C.	14.4° C.

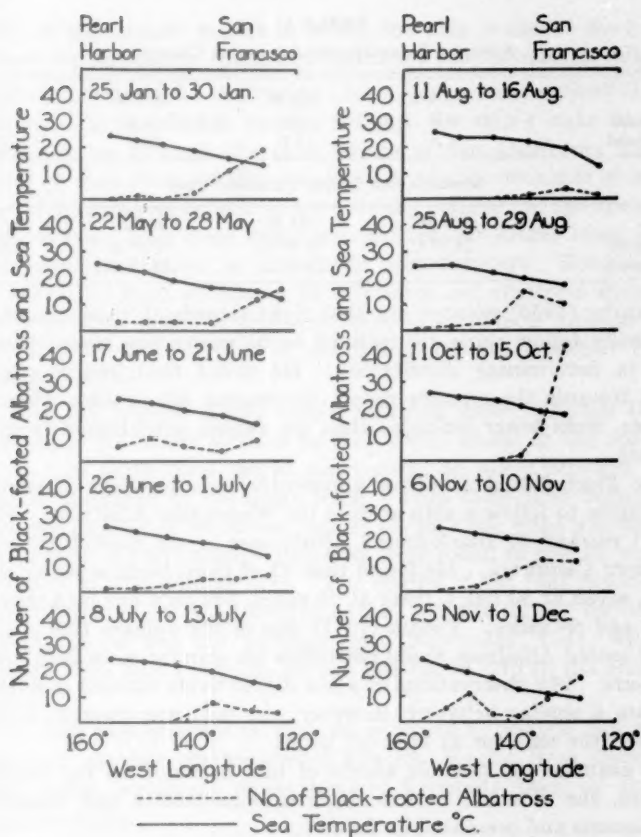


FIGURE 1. Correlation of daily numbers of Black-footed Albatrosses with temperatures of the sea.

The sea temperatures reflect the distinct change in water masses which one encounters between the American West Coast and the Hawaiian Islands. Sverdrup, *et al.* (1942) described an Eastern Central Water Mass which lies to the eastward of the Hawaiian Islands. This mass is in part formed by the boundary between the warmer water to the west and subarctic water to the east in the region of longitude 130 to 150 W. The number of Black-footed Albatrosses encountered diminishes as one passes westward out of the influence of the subarctic waters. The region of the 135th meridian might be considered as the westward limit of moderate albatross abundance.

TABLE 1  
AVERAGE BLACK-FOOTED ALBATROSS COUNTS

	155 W.	145 W.	135 W.	125 W.
Eastbound	0.8	2.3	4.8	17.3
Westbound	1.2	3.1	10.2	10.3

AVERAGE SEA WATER TEMPERATURES

	155 W.	145 W.	135 W.	125 W.
Eastbound	24.8° C.	21.4° C.	18.1° C.	13.7° C.
Westbound	24.5° C.	21.8° C.	18.8° C.	15.0° C.

Murphy (1936) pointed out that sight records of Tubinares which habitually follow ships are inclined to be misleading when they are used in determining distribution. He noted that vessels cruising north towards the equator report Wandering Albatrosses, *Diomedea exulans*, from lower latitudes than do vessels southbound from the equator.

The Black-footed Albatross apparently does not have as great an inclination to follow a ship as does the Wandering Albatross. Miller (1942) marked 25 Black-footed Albatrosses in the coastal waters off Southern California. He found that 12 of these birds repeated at 20 miles, seven at 30 miles, three at 40 miles, but only one bird repeated at 50 and 60 miles. Yocom (1947) was of the opinion that a single Black-footed Albatross would not follow his ship for more than four to six hours. My observations of a few distinctively marked individuals indicate a similar behavior; however, one bird was thought to have followed the ship for at least 12 hours.

To examine the possible effects of this behavior on my sampling method, the data are broken down into eastbound and westbound components and presented in Table 1.

The average counts from westbound transects show a tendency to continue westward in greater numbers than do the eastbound counts. With the possible exception of the data from 125 W., comparisons of the temperature of the sea water for the same transects do not reflect this relationship. It seems probable, therefore, that the tendency of the Black-footed Albatross to follow ships actually introduces a limited bias to my method of sampling their distribution and abundance. However, this error is not excessive and lumping the eastbound and westbound samples tends to average out the bias.

As in any animal, the distribution of this species is conditioned by food supply. There was little opportunity to carry out a study of the bird's natural food habits or food sources. However, it was assumed that the abundance of the albatross's food was related to the produc-

tivity of the oceanic waters in which the ship cruised. An indirect method for appraising oceanic productivity was devised as follows.

When eastbound for the Pacific Coast, it was often noticed that the number of large jellyfish passing through the ship's wake increased greatly as we entered the cold waters of the California Current. Assuming that these jellyfish would be a reliable indicator of oceanic productivity, it was decided to keep a daily estimate of the abundance of jellyfishes. This daily count was carried out rather more for my own amusement than as a scientific measurement. However, the correlation between abundance of jellyfishes and albatross abundance was so striking that it is presented here as an item of interest. The daily estimate of numbers of jellyfishes was accomplished by the following method.

Under the impact of the ship's churning wake, jellyfish became luminescent for many seconds as they rolled about in the disturbed waters. At night these bright glows could be easily detected by an observer stationed at the ship's stern. Thus some time during each night, the number of jellyfishes passing through the wake was counted. Four counts, of two minutes' duration, were found to give an accurate expression in a minimum time. The results of the four counts were averaged; this figure was recorded as the "jellyfish index" for the day. This technique was not adopted until November, 1945, when we departed from San Francisco on our last round trip to the Hawaiian Islands.

This trip was irregular in that we returned to Seattle, not to San Francisco; moving northeastward towards Seattle from Oahu, one enters cooler waters in more westerly longitude than on the San Francisco route.

Sea-water temperatures, Black-footed Albatross counts, and jellyfish indices gathered on this last cruise are plotted in Figure 2.

The curve for the Black-footed Albatross shows general agreement with the abundance of jellyfishes; both albatross and jellyfish tend to increase as sea temperatures decrease. Stomach contents of Black-footed Albatrosses examined by Miller (1940) and Martin (1942) included such items as squid beaks, fish bones, fish eggs and seaweed tips. Other observers (Fisher, 1945, and Yocom, 1947) reported this bird catching flying fish. Thus, from data on food habits we would not interpret the correlation evident in Figure 2 as indicating that the albatrosses forage on jellyfish, but rather that concentrations of both of these animals are confined to low temperature waters, rich in nutrients and of a high biotic productivity.

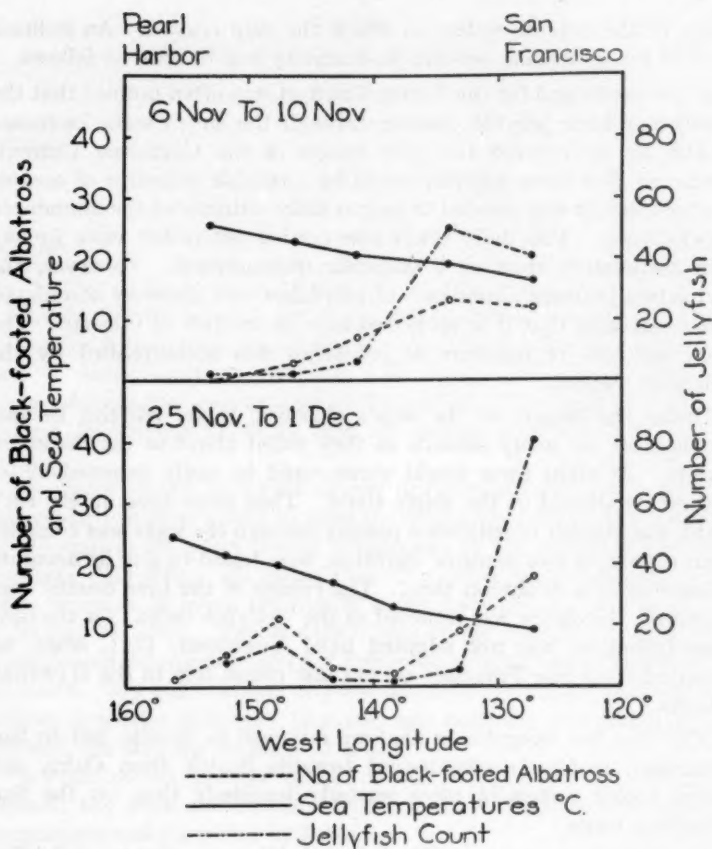


FIGURE 2. Relation of temperature of the sea, number of jellyfishes, and number of Black-footed Albatrosses seen each day.

This general relationship of abundant life with low sea temperature is common knowledge among oceanographers. Murphy (1936) summed up much of this information in his discussion of the nutritional basis of marine life. He pointed out that low temperature waters are favorable to a high gaseous content and are richer in mineral nitrogenous compounds than are temperate or tropical waters.

Miller (1940) made an intensive study of the distribution of Black-footed Albatrosses at 32 hydrographic stations in the coastal waters of Southern California. The ocean area sampled in Miller's study extended 190 miles offshore and was approximately equal to 13 hours of





Photo by Irven O. Buss

BLACK-FOOTED ALBATROSS: North Pacific, March, 1945.



cruising at 15 knots by my vessel. Thus my data for a single daily sample of albatross abundance transects the entire offshore area considered in Miller's study. His observations were also made in a more southerly latitude. These differences make anything more than general comparisons most difficult, but it is interesting to note that Miller found Black-footed Albatrosses concentrated locally over a narrow "cold tongue" of sea water which varied from a few to 25 miles in width. This "cold tongue" was characterized as an area of turbulence, rich in nutrient salts, and supporting a wealth of plankton. This phenomenon of extreme local concentration of albatrosses may in part be characteristic of the lower reaches of the California Current. If similar areas of local concentration occurred offshore from the Golden Gate, they were not noticed in my observations. Yocom's (1947) observations offshore from the Golden Gate were similar to my own; he did not note any narrow zones of concentration of Black-footed Albatrosses but rather observed that the birds were uniformly distributed over the waters cruised by his ship.

The most westward longitude reached in Yocom's four oceanic stations was  $136^{\circ} 32' W.$  This is still within the zone of influence of sub-arctic water and hence falls at the westward edge of albatross abundance as determined by my transects.

Only four crossings (two round trips) were made through the Central Pacific. These transects were noteworthy for the extreme scarcity and even complete absence of Black-footed Albatrosses throughout the reaches of this vast, uniform water mass. Daily observations frequently continued for a week and more without a bird of any species being seen. It is pointless to treat these notes in graphical or tabular form. They can best be summarized as follows:

Steaming on a modified great circle track-line from San Francisco to the New Hebrides, the last Black-footed Albatross was observed at Lat.  $21^{\circ} N.$ , Long.  $149^{\circ} W.$ , on January 29.

No Black-footed Albatrosses were recorded on passages during March and April from New Hebrides to the Solomons to the western Carolines, or from the Carolines to Okinawa to Saipan.

En route to Pearl Harbor from Saipan, the first Black-footed Albatross was encountered at Lat.  $15^{\circ} 40' N.$ , Long.  $176^{\circ} 20' E.$ , on April 21.

Running a modified great circle course from San Francisco to Eniwetok, the last Black-footed Albatross was seen east of the Hawaiian Chain at Lat.  $35^{\circ} N.$ , Long.  $151^{\circ} W.$ , on August 28. This cruise continued from Eniwetok to the Philippines with no Black-footed Albatrosses recorded. Likewise, no birds of this species were observed on the eastbound return trip from the Philippines which ended at Pearl Harbor in early October.

## LAYSAN ALBATROSS

Only ten Laysan Albatrosses were observed during the 45,000 miles cruised in 1945. They were recorded on the following dates:

January 25: 37° 37' N., 124° 53' W.; one Laysan Albatross, "remained far astern."

February 1: 8° 30' N., 163° 35' W.; one Laysan Albatross, "scaling rapidly downwind—paid no attention to the ship."

April 22: 17° 30' N., 171° 20' W.; three Laysan Albatrosses, "followed wake for an hour."

November 29: 39° 40' N., 139° W.; one Laysan Albatross, "appeared far astern for a few minutes." 40° 32' N., 138° 17' W.; one Laysan Albatross, "again far astern, did not remain in vicinity for more than a few minutes" (possibly a repeat).

November 30: 44° 10' N., 132° W.; two Laysan Albatrosses, "scaling over wake—foraging for refuse with Black-footed Albatrosses."

December 1: 47° 15' N., 126° 45' W.; one Laysan Albatross, "foraging in ship's wake with Black-footed Albatrosses."

Laysan Albatrosses showed less inclination to follow the ship than did the black-footed species. However, it was noted on April 22 that three of them (Laysans) scaled along behind the ship for an hour (15 nautical miles). On two occasions they mingled with Black-footed Albatrosses and adopted the latter's scavenging habit.

## SUMMARY

Notes on albatrosses were recorded on 45,000 nautical miles of North Pacific cruising during 1945.

Ninety-nine per cent of all albatrosses seen were the Black-footed Albatross; one per cent was the Laysan Albatross; Short-tailed Albatrosses were never encountered.

Approximately half of the total miles cruised were logged between the U. S. Pacific Coast and the Hawaiian Chain. Ninety-nine per cent of all Black-footed Albatrosses observed were seen in this area.

Black-footed Albatrosses tend to concentrate over the cool waters offshore from the Pacific Coast of the United States. This is probably in response to the abundant food present in these low temperature areas. These concentrations probably exist in all seasons of the year and indicate a substantial non-breeding population.

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#### GENERAL NOTES

**Raccoon Predation on the Great Blue Heron, *Ardea herodias*.**—On June 22, 1950, while I made observations on a heron rookery located in the Crab Orchard Lake Wildlife Refuge in southern Illinois, a raccoon, *Procyon lotor hirtus*, was observed to climb a tree containing heron nests. The raccoon entered a nest which was located 50 feet from the ground; it was seen feeding on remains of Great Blue Herons. It remained in the nest for 30 minutes, after which time it left the tree. About five minutes later the raccoon again climbed the tree, entered the nest, and continued its eating activities. Supporting evidence of predation by raccoons, was several scats containing heron feathers, that were found on logs in the vicinity of the rookery. The total effect of this predation on the heron colony is not known, but it is conceivable that young herons might be eaten by raccoons, both in the nest as well as during their early flight period.—ALVIN C. LOPINOT, *Department of Zoology, Southern Illinois University, Carbondale, Illinois.*

**Nest of the Yellow-crowned Night Heron, *Nyctanassa violacea*, in Kansas City, Mo.**—The Yellow-crowned Night Heron has been a summer visitor in the Kansas City region with increasing frequency during the past decade. Most of these birds have been in the immature plumage and, with only two exceptions, were reported in late summer.

A nest was discovered in its earliest stages of construction on May 13, 1950, and a number of local bird students made observations until August 10. Three young were reared successfully. This seems to be the northernmost nesting positively known in western Missouri or eastern Kansas.

The nest was on the fork of a horizontal limb up about 70 feet in a walnut tree in a river bottom tract of virgin timber in Swope Park which is within the city limits. On May 13, the pair was discovered courting in the "stick ceremony." The stick was placed across the fork which already supported a half-dozen sticks. Then the herons stood side by side but facing opposite directions and exchanged stroking gestures in which each passed the side of the beak downward against the primaries of the other's folded wing. The nest grew slowly. May 16, one heron was sitting on the nest

which was still too open to conceal an egg. May 20, the nest was thicker and perhaps an egg was under the sitting female. The male perched near by. Both birds seemed to pass the daylight hours in dozing. Observations were made with binoculars from a path about 100 feet from the tree. Incubation was uneventful. The first nestling was visible June 29. Subsequently, there were three nestlings of different ages; the youngest was last seen in the nesting tree on August 10. Apparently, all survived despite a July of record-breaking low temperature with much rain and wind.—HENRY M. HARFORD, 926 Argyle Bldg., Kansas City 6, Mo.

**Records of Sabine's Gull, *Xema sabini*, in Massachusetts.**—On May 30, 1950, I saw from the beach at the tip end of Nauset Point, Cape Cod, Mass., an adult Sabine's Gull. The bird flew directly away from me at very short range and settled in the water in the middle of the tidal channel not over 100 feet away. I had a good chance to observe it through 7 x 50 Zeiss binoculars, although the bird was easily identifiable without any such aid. This appears to be the thirteenth record for this bird along the Massachusetts coast, since the first specimen was taken in Boston harbor September 27, 1874 (Brewster), and therefore seems worthy of report.

The second report for Massachusetts (Orn. and Ool., 14: 95, 1889) reads "We have in our hands a Sabine's gull taken at Cape Cod, Massachusetts, in 1888. The bird was in immature plumage." The place and date are not given. On August 21, 1889, G. S. Miller, Jr., reported one shot in Cape Cod Bay west of N. Truro. The fourth record for the state was by F. Seymour Hersey of two taken at Chatham, September 2, 1912; the fifth was on August 21, 1927, at Marshfield, by Allen H. Wood, Jr. and John Smith.

The 'Bulletin of New England Bird Life' and 'Records of New England Birds,' from 1945 to the present time, show the following recent records.

September 7, 1937.—One adult collected by Ludlow Griscom at sea—off Chatham, Cape Cod, specimen now mounted in Museum of Science, Boston (in breeding plumage, just starting to molt). July 27 to September 2, 1941.—One adult in winter plumage found by Ludlow Griscom at Monomoy, Chatham, Cape Cod, and present intermittently throughout that time. August 16, 1941.—C. Russell Mason and Jessie H. Mason saw one at Ellisville (near Plymouth). March 8, 1942.—One adult closely observed and well described at Gloucester by Lt. Richard Allyn. May 26, 1942.—One adult closely observed at Monomoy, by Kraus and Winslow; the bird was lame and appeared exhausted. May 20, 1944.—One seen by Ludlow Griscom at Monomoy. September 3, 1945.—One bird in second-year winter plumage observed by Ludlow Griscom and William Cottrell off Chatham. September 27, 1947.—One observed off Nauset, Eastham, Cape Cod, by Ludlow Griscom and party.—C. RUSSELL MASON, *Massachusetts Audubon Society, 155 Newbury Street, Boston, Massachusetts.*

**Method of Feeding of the Black Skimmer, *Rynchops nigra*.**—The feeding habits of the Black Skimmer have been the subject of comment by many different writers, and their accounts are not all in agreement. The earlier writers generally seem to have believed that the bird obtains its food by skimming and taking its food from the surface of the water. Arthur (1921) wrote that the food is obtained mostly by wading and catching food while afoot. Pettingill (1937) and others observed the skimming for food. Later, Murphy (1936) reviewed some of the literature on the manner of feeding and offered a number of theoretical considerations, but seemed to lean to the belief that the skimming behavior had significance other than being a simple direct way of catching food.



It is not intended here to try to refute any previous account, except as may result from a simple account of what has been carefully observed over quite a number of years. During the 1920's and 1930's my work was located so that I was within sight or sound of skimmers for periods that would probably total several years. It was realized that there was a problem in this matter of feeding, and the observations were made with a view to being sure of the truth of the matter.

The following premises seem valid, and the basis for reaching the conclusions will follow:

- 1) The skimmer feeds principally, perhaps entirely, by skimming and catching small fish and shrimp in its bill;
- 2) The food is carried directly to the nest, and not swallowed to be regurgitated later, a fact which limits the feeding range;
- 3) The time of greatest food consumption coincides with a seasonal peak of suitable food in suitable location to be obtained by skimming.

In the skimmer colony there is evidence of the type of food and the condition in which it is delivered to the young birds or to the adult that is incubating. There are dried fish and shrimp in wide variety, and small heaps of the scales and other indigestible matter which have been cast up. It may be difficult for an adult bird, with its mandibles of unequal length, to pick up a fish from the sand once it is dropped, and some of the discarded food in the colony may have been dropped and not recovered. Very young birds often have the tail of a fish, or the appendages of a shrimp sticking out of their mouths, simply because their alimentary canals are not yet long enough to accommodate food of the size furnished. They appear to have been fed food that is very fresh, not partly digested matter.

Just beyond the periphery of the colony the adults may be seen going toward the feeding grounds, or returning with a fish or shrimp held crosswise in the bill.

Somewhere near the colony there is usually a group of resting birds. Some of these are non-breeders, usually identified by the white band across the hind neck and the white back of and over the eye as in typical winter plumage. Perhaps some are birds that are not incubating or hunting food at the time. There are certain activities in this group, such as bathing in shallow water, which might seem to indicate feeding on foot, but if such feeding occurs it is infrequent and incidental.

Our salt creeks and rivers have many shallow sloping mudflats or sandbars. This is where the skimming is done. At certain times of tide there are many skimmers, singly or in groups of several, skimming up against the wind over a beat a few hundred yards in length. At the end they frequently rise a few feet and fly back to the starting point for another beat. There is no difficulty, under favorable circumstances, in seeing fish or shrimp being caught. Now and then a bird will pick up a grass stem, or perhaps strike the lower mandible on some submerged thing; then the head turns under easily, and the long wings lift the bird a little until it can regain its poise before resumption of the skimming. The birds often skim in water an inch or less in depth.

Many of these mudflats have a growth of salt-marsh cord grass, *Spartina alterniflora*, down to about three and a half feet above low water, and during the summer months the shrimp and small fish crowd into the shallow water as the tide rises, ready to move among the grass roots when the water reaches them. There is a similar recession as the tide leaves the grass roots. It is customary for those who catch shrimp with a cast net to go out "when the tide leaves the marsh" and to cease casting when the flood again returns to that level, as most of the shrimp are then in the grass. So there is about half of the tidal cycle when skimming is practicable,

and though there are some shores where the birds can feed throughout the tide, their feeding is done mostly on the low ebb and the low flood, and is not continuous during the day. A stiff breeze will cause enough rough water to drive the shrimp away from all but sheltered banks on some days; this may have some bearing on the night-feeding of the birds, though it is done sometimes in fall and winter, as well as in the summer when there is a much greater demand for food.

The partly grown young of the prawn, *Penaeus setiferus*, migrate into these muddy creeks in great numbers in June, July, and August and are locally known as "June shrimp." The concentration is great, and it is customary to hear cast-net fishermen boast of catching a quart at a throw. The "quart at a throw" is not vouched for here, but told to illustrate how numerous they are. There are also many small fishes in the shallow water at this season. The skimmers lay their eggs in June, and the food requirements per adult pair reaches a peak about July, coinciding with the coming of the "June Shrimp."

When skimming, the birds depress the lower mandible very little. Most of the separation of the mandibles is accomplished by lifting the outer end of the upper mandible as a result of flexing in the nasal region. This kinetic function of the skull has been described by Coues (1892) and involves the movement of several of the bones of the skull. This movement is used in various ways by many different species of birds. The Least Tern, *Sterna albifrons*, in one part of its courtship, uses a motion much like that described here for the skimmer.

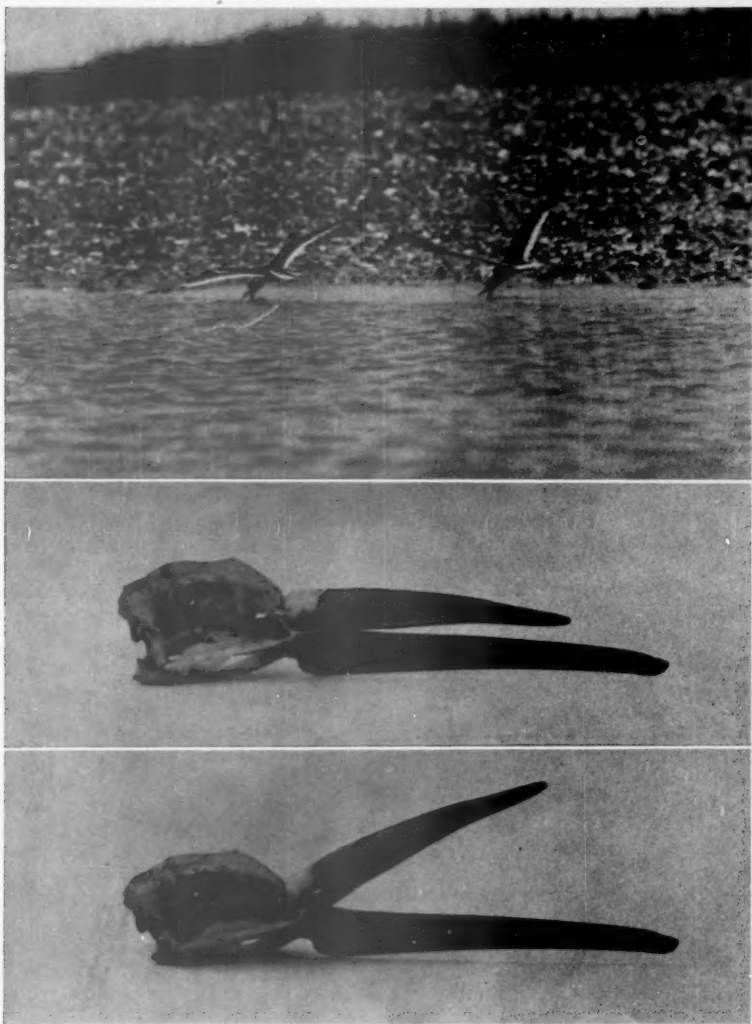
What actually happens in skimming is that the quadrate bone rocks forward on its upper articulation with the cranium, pushing forward on the slender quadratojugal bones which in turn bend upward the outer end of the upper mandible. The much shorter pterygoid bones also move forward and assist in the motion.

In order to show more clearly how this is done, two photographs (Plate 8, center and bottom) were made of a rough skull with the horny sheath of the bill intact. The sclerotic bones were not considered important and were left out. One photograph shows the bill at rest; in the other it is opened in the approximate skimming position. It will be seen that the conformation of the skull at the forehead is such that this motion may readily be accomplished.

This peculiar manner of opening the bill was first noticed in photographs. Careful watching with binoculars later indicated it to be a common practice.

If the tips of the mandibles of a freshly collected and limp specimen are gently pulled apart, the skull bones readily assume the skimming position. It will then be seen that the lower mandible continues to lie nearly in line with the long axis of the neck, and that the mouth at the angle remains nearly closed. It might almost be said that the bird opens its bill but keeps its mouth closed.

It does not seem probable that the bird could hold one fish or shrimp crosswise in the bill and continue to skim for another, so it may be necessary for each bird to fly a round trip from the nest to the feeding grounds for each bit of food carried to the young or to the female on the nest (courtship feeding has been reported in this species). Thus, the distance from the feeding grounds to the colony must be much less than if regurgitation were practiced. During the summer of 1942, I was assigned to the U. S. Dredge DeWitt Clinton which was working south in the Intercoastal Waterway a few miles south of the Savannah River. We made many trips back and forth each way for several miles. Just below Thunderbolt, Chatham County, Georgia, there was a colony of perhaps 50 pairs of skimmers, the only colony in the vicinity. The dredge worked ahead 500 or 600 feet a day, and at first we saw no food-carrying skimmers. Then at three and one-fourth miles from the colony, we began



(Top) ADULT SKIMMERS SKIMMING. (Center) LATERAL VIEW OF SKIMMER SKULL WITH BILL CLOSED. (Bottom) SKULL OF SKIMMER SHOWING MANDIBLES SEPARATED AS IN SKIMMING.



to see a few and, from two and one-half miles on, the feeding birds were common. The observations were limited to birds that were actually carrying food, in order that no non-breeding birds would be counted, as these might feed for themselves nearly anywhere.

Referring again to the position of the bill, the skimming birds shown in the photograph would show the position more accurately had the camera been more nearly at right angles to the birds' flight.

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 PETTINGILL, O. S. 1937. Behavior of Black Skimmers at Cardwell Island, Virginia. *Auk*, 54: 237-244, 2 pls.

—IVAN T. TOMKINS, 1231 East 50th St., Savannah, Georgia.

**Food of the Barn Owl, *Tyto alba pratincola*, in Hancock County, Ohio.**—The purpose of the present work was three-fold: 1) to discover whether any as yet unreported species of small mammals from Hancock County, Ohio, would be found in the pellets of the Barn Owl; 2) to determine the percentage of occurrence of the various small animals in the pellets; and 3) to determine the value of the Barn Owl as a check upon small mammal populations in this area.

Hancock County is in the northwestern part of Ohio, 45 miles from Lake Erie and 50 miles from the Indiana state line. For the most part the surface of the county is flat, being located in the till plain areas of the state. At its western and eastern borders, however, it becomes slightly rolling. Seventy-seven per cent of the county is under permanent cultivation; 10 per cent is made up of wooded areas, and the remaining 13 per cent of the land area is in permanent pasture, roadways, and town-sites.

During the summer of 1948 I located three nests or roosting places of the Barn Owl. One of these was on a small balcony measuring two feet by three feet that fronted a third-story window at the home of R. W. Kirk in Findlay, Ohio. A brood of five young was reared on this balcony. Another nest was placed on a platform measuring two feet by two feet and located just beneath an opening underneath the eaves of a large barn on the Clyde Worden farm, five miles west of Findlay, Ohio, on state route 224. The third site from which pellets were collected was a roosting place located in a building on the property of the Continental Sugar Company's refinery at the west edge of Findlay.

From beneath the balcony at the Kirk home 20 pellets were collected. There were no recognizable pellets on the balcony, but the floor of the structure was covered to a depth, varying from one to three inches, with a mass of crushed and broken pellets, fecal material, and dry twigs from the nests of pigeons that had nested on the balcony before the owls took possession. The entire mass was felted together by the fur of the mammals that had been consumed. I obtained nine pounds of this material. From the nest on the Worden farm 122 pellets were collected and from the roost at the Sugar Refinery 102 pellets.

All of the lower right mandibles were separated from the pellets or the nesting debris that was collected. Each of these was regarded as one occurrence of an animal. The jaws were retained to enable the author to distinguish between

## SPECIES FOUND IN PELLETS OF BARN OWL

		Occur- rences	Per cent total
<i>In 9 pounds of debris from nest at Kirk's</i>			
Norway Rat	<i>Rattus norvegicus</i>	10	1.56
Meadow Mouse	<i>Microtus pennsylvanicus</i>	572	89.23
House Mouse	<i>Mus musculus</i>	15	2.34
Short-tailed Shrew	<i>Blarina brevicauda</i>	28	4.36
Cottontail*	<i>Sylvilagus floridanus</i>	3	0.46
European Starling	<i>Sturnus vulgaris</i>	3	0.46
English Sparrow	<i>Passer domesticus</i>	6	0.93
Goldfinch	<i>Spinus tristis</i>	1	0.15
Pigeon	<i>Columba livia</i>	1	0.15
		639	
<i>From 122 pellets from Worden farm</i>			
Norway Rat	<i>Rattus norvegicus</i>	3	1.49
Meadow Mouse	<i>Microtus pennsylvanicus</i>	153	76.04
House Mouse	<i>Mus musculus</i>	1	0.49
Short-tailed shrew	<i>Blarina brevicauda</i>	20	9.94
English Sparrow	<i>Passer domesticus</i>	1	0.49
Deer Mouse	<i>Peromyscus</i> , species	9	4.47
Least Short-tailed Shrew	<i>Cryptotis parva</i>	12	5.96
Least Weasel	<i>Mustela vison</i>	1	0.49
Long-tailed Weasel	<i>Mustela frenata</i>	1	0.49
		201	
<i>From 102 pellets from roost at Sugar Refinery</i>			
Norway Rat	<i>Rattus norvegicus</i>	5	2.24
Meadow Mouse	<i>Microtus pennsylvanicus</i>	181	81.22
House Mouse	<i>Mus musculus</i>	4	1.79
Short-tailed Shrew	<i>Blarina brevicauda</i>	17	7.61
English Sparrow	<i>Passer domesticus</i>	4	1.79
European Starling	<i>Sturnus vulgaris</i>	2	0.89
Deer Mouse	<i>Peromyscus</i> , species	6	2.68
Catbird	<i>Dumetella carolinensis</i>	1	0.44
		223	
<i>Summary of remains regardless of location of nest or roost</i>			
		Occurrences	Per cent Total
Norway Rat		18	1.69
Meadow Mouse		906	85.16
House Mouse		20	1.88
Short-tailed Shrew		65	6.11
Cottontail		3	0.28
Deer Mouse, species		15	1.41
Least Weasel		1	0.09
Long-tailed Weasel		1	0.09
Least Short-tailed Shrew		12	1.41
European Starling		5	0.47
English Sparrow		11	1.03
Goldfinch		1	0.09
Pigeon		1	0.09
Catbird		1	0.09
		1063	

\* Immature, approximately one-fourth grown.



*Peromyscus* spp., *Mus musculus*, *Reithrodontomys*, *Synaptomys*, and *Microtus*. Below is a list of small mammals known to be present in Hancock County, either from sight or trapping records. Although the adults of some of the species are too large to be used as food by the Barn Owl, their young are not.

Striped Spermophile	<i>Citellus tridecemlineatus</i>
Eastern Chipmunk	<i>Tamias striatus fisheri</i>
Eastern Flying Squirrel	<i>Glaucomys volans</i>
Fox Squirrel	<i>Sciurus niger rufiventris</i>
Red Squirrel	<i>Tamiasciurus hudsonicus loquax</i>
Cottontail	<i>Sylvilagus floridanus</i>
Wood Mouse	<i>Peromyscus leucopus noveboracensis</i>
Deer Mouse*	<i>Peromyscus maniculatus bairdii</i>
Meadow Mouse	<i>Microtus pennsylvanicus</i>
House Mouse	<i>Mus musculus</i>
Norway Rat	<i>Rattus norvegicus</i>
Least Short-tailed Shrew	<i>Cryptotis parva</i>
Short-tailed Shrew	<i>Blarina brevicauda</i>
Cinereous Shrew	<i>Sorex cinereus</i>
Mink	<i>Mustela vison</i>
Long-tailed Weasel	<i>Mustela frenata noveboracensis</i>
Least Weasel	<i>Mustela rixosa allegheniensis</i>
Muskrat	<i>Ondatra zibethica</i>
Striped Skunk	<i>Mephitis mephitis nigra</i>
Opossum	<i>Didelphis virginiana</i>

\* Studies of the deer mouse populations of this county previous to this study indicate that *P. maniculatus* outnumbers *P. leucopus* 8 to 1.

#### SUMMARY

1. No species of small mammals, as yet unreported for Hancock County, Ohio, were found in the pellets of the Barn Owl, *Tyto alba pratincola*, collected from three different locations near Findlay, Ohio.

2. The meadow mouse, *Microtus p. pennsylvanicus*, comprised 85.16 per cent of the food consumed.

3. The pellets collected from the Worden farm, located in the open countryside, contained fewer bird remains, 0.48 per cent, than did those collected from the two locations within the city, 2.35 per cent.

4. Remains of game species were represented by the cottontail and the long-tailed weasel; they constituted a negligible amount (0.37%) of the total food. Four skulls of a total of 1063 were of these two species.—RICHARD S. PHILLIPS, *Biology Department, Findlay College, Findlay, Ohio.*

**Notes of the Eastern Screech Owl, *Otus asio naevius*: A Correction.**—I ask the privilege of making in the pages of 'The Auk,' where most of my little contributions to ornithological literature have been made since 1888, a correction of a statement in A. C. Bent's 'Life Histories of North American Birds of Prey' (Part 2, 1938), where, on page 256, in treating of the voice of the Eastern Screech Owl, Mr. Bent says that I had given him a description of two of the notes and then proceeds to quote me, but unfortunately not quite correctly. What I actually sent him was a description of what I considered to be three separate vocal utterances. I cannot now say just how I worded the description which my good friend Cleveland Bent misread, but it must have been substantially as follows: (1) The well-known wail, or whinny; (2) the so-called love song consisting of a series of short, even, low notes delivered with varying degrees of rapidity and varying in pitch, sometimes with the first part slow and the latter part rapid and virtually a trill; (3) 'wheooo,' a mellow whistle with a

falling inflection, often followed by three shorter notes, each a very little higher than the preceding note—"wheooo, woo, woo, woo."

I think I got the term "love song" for the second of these from Bradford Torrey, but I have never applied it to the first, the wail or whinny, and I should not agree with Mr. Bent in using it for Thoreau's Screech Owl described in 'Walden.' Now from later observations I am inclined to call it the courtship song and to consider the wail to be the territorial song.

This revision of my contribution to the "Life Histories" leaves it in substantial agreement with Dr. Tyler's description of these notes on page 257.

When an author corrects in print a published statement of his own, it is a good custom for owners of copies of the publication containing the statement to make the correction in their copies, and it is in the hope that readers will follow that custom that I have written this note.—FRANCIS H. ALLEN, 9 Francis Ave., Cambridge, Mass.

**Air-sacs in the English Sparrow.**—These observations were secured in connection with an investigation to determine a desirable method for tracing the air-sacs in birds. The English Sparrow, *Passer domesticus*, and the Rock Dove, *Columba livia*, were used because both were abundantly available and because most work on avian air-sacs has been based on the latter. The literature on the air-sacs of the Pigeon or Rock Dove is so comprehensive that it was thought best for purposes of this discussion to contrast the system in the English Sparrow with that of the Pigeon. Nomenclature is that of Müller (Smiths. Misc. Coll., 50: 365-414, 1908).

The Department of Biology at Clark University furnished facilities and materials for the investigation. I am indebted to Dr. R. F. Nunnemacher for counsel and encouragement.

**Method.**—Both Woods Alloy and Latex were used as media of injection through the trachea. Although Woods Alloy has enjoyed the praise of many investigators, especially Gilbert (Auk, 56: 57-63, 1939), I found its use inconvenient because of the necessary temperature controls, particularly in the smaller English Sparrow. I found pigmented Latex superior to the alloy in that no temperature controls were needed and the resulting molds were elastic, permitting freer examination.

In the Pigeon I was able to secure molds of finer detail than those shown in Gilbert's plates of "casts" (which really are not casts at all but rather internal molds), including the extensive osseous sacs of the pelvic girdle and of all the vertebrae, by maintaining higher temperatures during a slower drip process of injection with Woods Alloy. The word cast is defined here to indicate a copy of the original; mold, the original in reverse.

#### *The Primary Air-Sacs.*

**The Sacci Cervicales:** The cervical air-sacs are in direct communication with each other, only a medial line indicating their dual origin. The resulting sac is symmetrical and tongue-shaped in the mold; its apex extends forward to the tenth cervical vertebra. No pars ovalis is apparent. The cervical system of diverticula is present, though neither the canalis intertransversarius nor its diverticula pneumatize cervical vertebrae anterior to the third. (Perhaps the system reaches the atlas, as in the Pigeon, but if so it was not indicated by the Latex method of injection.) Ventral to the most posterior cervical vertebra each cervical air-sac communicates with the interclavicular sac. The thoracic system of diverticula is wanting.

**The Saccus Interclavicularis:** The interclavicular sac encases the anterior part of the thoracic cavity; it is not ostensibly divided into a medial and two lateral chambers. The former is present only in the form of two delicate flaps in the mold which form

the roof of a passageway for the trachea entering the thoracic cavity. The subscapular and axillary diverticula are prominent as in the Pigeon. The humerus, however, is only insignificantly pneumatized, the axillary diverticulum hardly penetrating the pneumatic foramen. There are two tiny fringed diverticula whose homologies are not clear to the writer, one in front and one behind each axillary diverticulum. The interclavicular air-sac forms a broad medial connection with the coalesced anterior intermediate sacs.

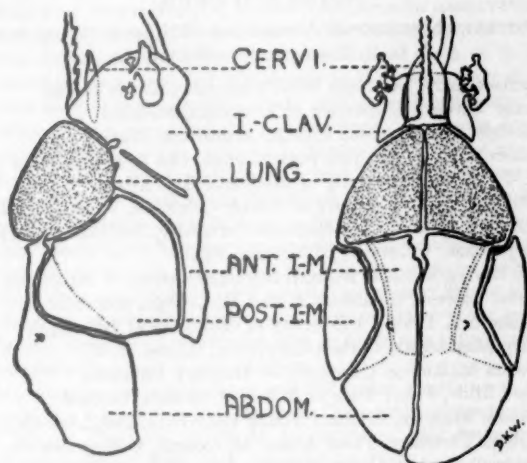


FIGURE 1. Lateral and dorsal view of primary air-sacs of the English Sparrow.

**The Sacci Intermedii Anteriores:** Here the English Sparrow departs most radically from the Pigeon. I suspect the large symmetrical sac coincident in outline with the sternum and just above it is a coalescence homologous to the pair of anterior intermediate sacs of the Pigeon. In addition to the broad medial connection with the interclavicular sac, mentioned above, there is a tubular (in the flesh) intrathoracic connection with this sac. Also the latero-ventral edge of the lung is strongly attached to the anterior sac.

**The Sacci Intermedii Posteriores:** The posterior intermediate sacs are paired as in the Pigeon, and the left sac is slightly larger than the right. In proportion to size these sacs in the English Sparrow are very much larger, occupying the position of both sacci intermedii of the Pigeon. They have regular edges and are not connected with any other sac.

**The Sacci Abdominales:** The paired abdominal sacs differ least from those of the Pigeon. The mold of these sacs encloses the viscera as do the shells of a nut. The right sac is larger. Tiny diverticula are present about the inguinal region. Neither the femur nor the pelvic girdle is pneumatized.

**Summary.**—Latex molds of the air-sac system of the English Sparrow indicate that in addition to the interclavicular sac two other sacs have coalesced with their complements across the median line—the cervical sacs and probably the anterior intermediate sacs. Further simplification of the system in this species as compared to that of the Rock Dove is the lesser number of pneumatized bones, only the cervical

vertebrae being penetrated to any extent in the material examined. Homology of the large sac above the sternum is problematical; embryological investigation and comparison with other passerine species is needed to verify my supposition that this sac is the anterior intermediate.—DAVID K. WETHERBER, *Biology Department, Clark University, Worcester, Massachusetts.*

#### NOTES AND NEWS

##### STUDENT MEMBERSHIP AWARDS FOR 1951 SELECTED BY THE A. O. U. COMMITTEE ON EDUCATION

Samuel Andrew Arny, Louisiana State University, Baton Rouge  
Charles Omar Bartlett, University of Wisconsin, Madison  
Henry Lonsdale Bird, Bowdoin College, Brunswick, Maine  
Donald James Burdick, San Jose State College, San Jose, California  
Charles C. Carpenter, University of Michigan, Ann Arbor  
Richard William Fyfe, University of British Columbia, Vancouver, B. C.  
Frederick Kelker Hilton, Johns Hopkins University, Baltimore, Maryland  
Ned Keith Johnson, University of Nevada, Reno  
(Mr.) Clare Burten Kenaga, Western Michigan College of Education, Kalamazoo  
Pierre Chester Lawson, Oklahoma A. and M. College, Stillwater  
(Mrs.) Elizabeth E. Levine, University of California at Los Angeles  
John Stanley Maskiewicz, Cornell University, Ithaca, N. Y.  
Daniel Lawson McKinley, University of Missouri, Columbia  
Eric Leonard Mills, Fisher Park High School, Ottawa, Ontario  
Joseph Robison Murphy, Brigham Young University, Salt Lake City, Utah  
Paul Woodburn Parmalee, Texas A. and M. College, College Station  
Donald Caldwell Snoddy, University of Tennessee, Knoxville  
Andrew Spielman, Colorado College, Colorado Springs  
Keith Lynde White, University of Wisconsin, Madison  
Franklin Willis, University of Minnesota, Minneapolis

##### THE AMERICAN ORNITHOLOGISTS' UNION AND CONSERVATION

SINCE 1884 the American Ornithologists' Union has had a Committee on Bird Protection. In its early days the committee played a very active part in saving many plume species from virtual extinction at the hands of the millinery trade. The National Association of Audubon Societies—or, as it is now called, the National Audubon Society—which grew out of this early militant phase of the Committee's work has done a magnificent job in the 45 years of its existence and deserves all the support we can give it.

No one organization, however, can do everything that needs to be done for bird protection in an area having nearly 200 million people and covering a large part of the continent. This is especially true today, as population pressures and improved technology threaten soon to leave little unexploited land. In view of this situation, has the A. O. U. Committee on Bird Protection any right to sit on the sidelines and simply document annually for the membership the sad story of wildlife decline, without itself raising a hand to do anything about any of the many problems that are crying out for attention in every county in the land?

Have we the right to shirk all responsibility by saying that the National Audubon Society should do it? To date it has put \$41,742 into its Ivory-billed Woodpecker, California Condor, and Whooping Crane projects alone, of which only \$12,380 has as

yet been covered by special donations; and other similar projects only await the funds to finance them.

More, however, needs to be done. Swamps, marshes, heron colony sites, eagle trees, and other strategic habitats are disappearing from one community after another. Local extirpation threatens many species over large areas as civilization gradually destroys all of the special environment they require. I for one believe that the Bird Protection Committee of the A. O. U. must again, as in the days when Brewster and Dutcher were active in it, become a real force for conservation. Hoping that others will agree with me, I have accepted the chairmanship of the Committee for 1951. Who will help me? I know I can always look to the A. O. U.'s many busy professional members for advice, but it is largely to the membership at large that I feel I must turn for real help, especially those who through retirement from active business or other reasons have time and possibly funds they could devote to some phase of bird conservation work. Charles L. Broley, the retired Canadian banker who some 12 years ago at my suggestion undertook a program of research, photography, and propaganda on behalf of the Bald Eagle, is a case in point. His work has revolutionized our knowledge of the bird and helped the cause of its conservation immensely, incidentally bringing him election recently to full membership in the A. O. U.

If you agree with me that the A. O. U. has an obligation to do more than just sit on the sidelines and cheer or criticize, and if you feel you would like to help the Committee become more active, please write me. Let me know what you think you could contribute in time, travel, secretarial help, or funds to a rejuvenated Bird Protection Committee with a real action program.

If you are especially concerned about any particular situations or problems on which you would like to work as a member of the Committee, please mention them.—  
RICHARD H. POUGH, *Chairman, A. O. U. Committee on Bird Protection, American Museum of Natural History, New York, December 18, 1950.*

*Frank M. Chapman Memorial Fellowships.*—In order to perpetuate the memory of Dr. Frank M. Chapman and to continue his influence, a memorial fund under control of The American Museum of Natural History was established after his death in 1945 by Mrs. Elsie M. B. Naumburg and her husband, Walter W. Naumburg. Many of Dr. Chapman's friends and admirers have since contributed to this fund which has grown sufficiently to permit a grant or grants to be made from the income. The Frank M. Chapman Memorial Committee is happy to announce that the first awards may be allotted in 1951.

Applications for fellowships should be addressed to the Chapman Memorial Fund, care of the Department of Birds of the American Museum of Natural History, New York 24, N. Y. Applicants should state their training and experience and describe the nature and the scope of the proposed project as well as the plan of procedure, previous work on the project (if any), and the amount of financial aid that is required. They should also supply the names of one or more sponsors.

Projects that are eligible under the provisions of the Chapman Memorial Fund include field expeditions, travels undertaken for the purpose of intensive studies of behavior of species of birds or of bird colonies, and support of laboratory or museum studies—in fact, almost any phase of sound ornithological research. A sum of approximately \$2000.00 will be available for the first grants.

The American Museum of Natural History will be responsible for judging the qualifications of the applicants. Any necessary collections made during the tenure of a Chapman Fellowship will be deposited in the American Museum. Applications must be received before June 1, 1951.

ALTHOUGH our Membership Committee is functioning very efficiently, much real help can be provided by each and every one of us. Have you checked with friends who are interested in birds and who might become associated with us? What have you done recently to stimulate interest in the American Ornithologists' Union?

We are sorry to note that Bernard William Tucker, Corresponding Fellow of the A. O. U., died December 19, 1950, and that Lynds Jones, Fellow, died February 11, 1951.

THE editor regrets the scrambling of names on Plate 1 in the January, 1951, Auk. Please correct to read *Dendroica dominica stoddardi*.



## RECENT LITERATURE

**A Study of a Group of Penguins of Known Age.**—L. E. RICHDALE. (Biol. Monog. No. 1: i-viii, 1-88, 10 figs., 1 diagram, 56 tables, index, 1949. (Otago Daily Times and Witness Newspapers Co., Dunedin, New Zealand). Price, 12/6. Also available from the author at 10/, 23 Skibo street, Kew, Dunedin, S. W. 1, New Zealand.—This is the first of a series of monographs, contemplated by the author, that will summarize his excellent longtime studies of penguins, petrels, albatrosses, and shearwaters. The present monograph deals with the Yellow-eyed Penguin, *Megadyptes antipodes*, about which the author has already written a good deal. Twelve seasons of intensive work on the Otago Peninsula, New Zealand, were devoted to observations on 162 individuals whose exact age, place of hatching, and parents were known, and on 298 others whose approximate age was known. Each individual was identified by a series of punctures in the webs of the feet and by bands that bore numbers large enough to be read at a distance through a telescope. This is a carefully organized statistical analysis of the accumulated data.

Of 398 fledglings which entered the sea, the fate of 96 is known, four per cent returned to nest in their place of hatching, nearly eight per cent in the nearest subsidiary breeding place, seven per cent in adjacent breeding areas, and six per cent farther afield. The post-juvenile molt occurs from 14 to 18 months after the young bird enters the sea.

Young males are slower to start breeding than females. Of two-year-olds, only seven per cent of the males nested but nearly 48 per cent of the females; of three-year-olds, 36 per cent of the males nested and 95 per cent of the females; of still older birds a female is rarely left unmated, but because of a surplus of males some males are not successful in acquiring mates.

A definite correlation occurs between behavior and physiological condition. For example, if ready to produce eggs the female mates with a male; if the breeding urge is not so strong she "keeps company" with a male; and finally, if the urge has not developed she does not fraternize with a male.

For pairs that returned, the mating bond remained intact for 87 per cent in the succeeding season. One pair remained mated for 10 consecutive seasons. Males generally mate with females younger than themselves because the older males are usually more successful than younger males in getting their attention. There is one record of inbreeding; a brother and sister, hatched four years earlier, successfully mated and reared one young from two eggs in each of two successive years.

Although there is no significant increase in the longer dimension of eggs as the birds become older, there are significant increases in the width and in the weight of the eggs. Fertility is low in two-year-old females and negligible among two-year-old males. Fertility increases considerably among three-year-old females but is greater among those that are laying for the second season. Fertility reaches its maximum in both male and female among four-year-olds and possibly remains high throughout life.

The percentage of non-breeding birds in the adult population may reach 61. This surplus of potentially breeding birds and the resulting intra-sexual competition may be an aid to breeding efficiency. Non-breeding birds begin their feather molt earlier than do those that are nesting.

The postulate that colonial nesting birds do not breed before a numerical threshold is attained is not valid among petrels and penguins. Small colonies in these species are usually new ones formed by juveniles or young birds which tend to wander more

than do adults, and breeding does not occur because they are sexually immature. Sexually mature adults will nest successfully even when isolated in single pairs.

Many other details are given and comparisons are made with other species in order to develop broad generalizations. This monograph, along with Richdale's other publications, makes the life-history of this species one of the best known in the class of birds.—S. CHARLES KENDRIGH.

**Canada Geese of the Mississippi Flyway, with Special Reference to an Illinois Flock.**—HAROLD C. HANSON AND ROBERT H. SMITH. Bull. Ill. Nat. Hist. Survey, 25 (Art. 3): 67-210, 82 figs., 47 tables, March, 1950.—This publication represents, in the reviewer's opinion, a significant landmark in the literature of North American waterfowl. It is an attempt to assay the basic phenomenon of a waterfowl population on a year-round scale.

Following presentation of data on breeding range, migration routes, and winter concentrations, the relationships and history of goose behavior, goose hunting, and the annual bag of geese in the Mississippi flyway are discussed. The effects of differential hunting losses by age groups, crippling losses, and miscellaneous mortality factors are then estimated. The authors delve deeply into the literature and into field notes to present the productivity of the population. A section entitled "Population Survival" by the senior author in his own words goes on to "exploit the data as far as possible" in order to arrive at a picture of the population changes over the period from 1925 to 1944, using data from the Jack Miner Refuge in Ontario, and from 1940-1947, using data from Horseshoe Lake Refuge in southern Illinois. Application of the sum total of the above information to management of the Canada Goose in the Mississippi is discussed with a final section describing the "Present Situation" (up through 1948) which appears to be a reasonably healthy one.

The publication is so full of data that no attempt can be made to discuss any of it. Rather the most significant portions may be cited. Of these the publication of the hitherto unexplored mass of banding information obtained by Jack Miner at his famous Kingsville, Ontario, sanctuary is a major addition to the literature. The more detailed results of banding 5,247 geese over an eight-year period at Horseshoe Lake are outstanding. The compilation of field data from Canada, information on the place of the Canada Goose in the life of the Indians of the James Bay Region, and the correlation of migration and bag records from many states should also be listed.

One hiatus in the bulletin which seems significant is the lack of specific information on the relation of the goose concentration at Horseshoe Lake to agriculture practices, commercial clubs, and law enforcement problems.

The publication should be of interest to the systematist for its discussion of different "sub-populations" of Canada Geese in the eastern United States, particularly the delineation of a "Southeast population," while for the wildlife manager interest will center on the history of the Horseshoe Lake Refuge and its attendant hunting ills. Persons studying population problems *per se* will benefit from the techniques used in analyzing banding and age data of a wild population. Thus the bulletin will serve as a stimulus to further research in many diverse branches of ornithology.

It is hoped that the intensive work at Horseshoe Lake will be continued to provide detailed population information over a continuing period.—WILLIAM H. MARSHALL.

**Die Vogelwelt Macedoniens.**—WOLFGANG MAKATSCHE. Akademische Verlagsgesellschaft, Geest and Portig K. -G., Leipzig, pp. xi + 1-452, 145 figs., 14 col. pls., 1 map, 7 maps in text, 1950. Price, \$10.00.—The volume treats the bird life of

Macedonia, that area of the Balkans which consists of parts of northern Greece and southern Yugoslavia. The author covers his subject with great thoroughness based on five years of personal observations and a close study of the literature. The first part of the work (77 pages) contains a description of the geography, a history of the ornithological exploration, and a very detailed listing and descriptions of all the habitats with their typical species of birds. The area is characterized by a mixture of east Mediterranean elements such as *Emberiza caesia*, *Lanius nubicus*, and *Hirundo daurica rufula*, and of central European elements, most of which are restricted to the coniferous forests of the mountains. The total list of recorded species and subspecies is 339. No less than 38 species have been added to the breeding list in the last 35 years.

The body of the volume (pages 86-436) contains a very detailed annotated faunal list with dates, localities, habitats, and altitudes of the recorded species. When available, measurements and weights of collected specimens and dimensions of eggs are given. There is a bibliography of 280 titles and an index. The volume is well illustrated by 145 photographs of landscapes, of birds and their nests, as well as by 14 colored plates, three of which depict eggs. The emphasis throughout the volume is faunistic-ecological; it should serve as a solid foundation for the students of life histories and for the conservationist. This is one of the last areas of Europe in which some of the large hawks and water birds have a stronghold.—ERNST MAYR.

**Birds of the West.**—ERNEST SHELDON BOOTH. Illustrated by Harry Baerg and Carl Pettersen. (Stanford Univ. Press, Stanford, Calif.), xii + 402 pp., 8 col. pls., 12 photos., many drawings, 1950. Price, \$6.00.—This is a new edition of the work by the same title, published by the author in 1948 and reviewed at length by William H. Behle in 'Bird-Banding' (vol. 19: 185-186). Principally a handbook for the identification of birds in the field, it features a system of keys which, the author claims, will enable "a person ten years old, or a person eighty-five years old" to find out "the name of any bird he comes to, no matter how difficult the bird may be to identify." The book's organization and text differ only slightly from the original edition's but its usefulness is greatly enhanced by the addition of color plates depicting the more common bird species west of the Great Plains. On these plates, the artist (Harry Baerg) has succeeded admirably in arranging an impressively large number of birds. For example, the plate of ducks shows 55 individual birds, all in like positions. The appendix, which deals with such miscellaneous subjects as nests and eggs, bird photography, feeding tables, nesting boxes, bird banding, bird societies and journals, and bird books and check-lists, might well have included more reference material. Baker's 'The Audubon Guide to Attracting Birds,' one of the best books of its kind, is not mentioned, and there is no listing of books or check-lists on the birds of Idaho, Montana, Colorado, Utah, Nevada, and Arizona—states where the work will be used. The National Audubon Society's former Broadway address is given (p. 386) even though the Society moved to its quarters on Fifth Avenue over ten years ago.—OLIN SEWALL PETTINGILL, JR.

**La Distribution et La Vie des Oiseaux en Serbie.**—S. D. MATVEJEV. Academie Serbe des Sciences, Monographies—T. 161, 363 pp., Belgrade, 1950.—This volume on the bird life of Serbia is in Serbian but with a short (11 pages) French summary. The first part of the volume (pp. 9-99) is an analysis of the ecology of Serbian birds. The second part (pp. 101-122) contains a zoogeographical analysis, and finally the third part (pp. 123-300) a listing of the recorded species with a number of distribution maps. This publication fills a very distinct gap in the literature on Balkan birds.—ERNST MAYR.

**A Naturalist in Sarawak.**—E. BANKS (Kuching Press, Kuching, Sarawak), 125 pp., 2 maps, 1949.—The author was for 25 years curator of the Sarawak Museum; when I met him last summer he was working in the Bird Room of the British Museum. This is a curious little book. Though it embodies a great deal of work, both in Sarawak and in European museums, there is not a scientific name in the book, and the data themselves are presented in such condensed form as to lose some of their value. Nevertheless there is much information here about geographical variation and distribution in the East Indies, particularly Borneo, and about the factors responsible for the fauna as it exists today. There is also a most interesting chapter on the great caves frequented by hordes of edible-nest swiftlets and bats. —DEAN AMADON.

**A New Journal—'Columba.'**—Ever since 'Bird-Lore' has shifted emphasis to conservation we lack in this country a good popular bird journal for the beginner. The recently founded journal 'Columba' fills this gap in Germany. It is furnished with attractive photographs, sketches for the beginner, short essays on the various species, life histories, and bird calendars. To the more sporting readers may appeal an identification contest in each issue, showing photographs of a bird nest, of a bird in flight, and of a female or young. Though evidently addressed to a lay audience, the contributions are consistently of high level. Orders may be placed with Hans Taubenberger, Schwärzenbach am Tegernsee, U. S. Zone, Germany. —E. MAYR.

ARMSTRONG, EDWARD A. 1950. Right thing, wrong time. *Animal Kingdom*, 53 (6): 174-179, 4 photos.—A popular account of "releasers" and conditioning that cause "displacement activity" which is often odd and inappropriate activity "set off" by unusual circumstances.

ARMSTRONG, EDWARD A. 1950. Intruder responses by birds outside their breeding areas. *Brit. Birds*, 43 (10): 332.—"Incomplete mobbing" by Arctic Terns.

ASMUNDSON, V. S. 1950. Sex-linkage in the turkey (*Meleagris gallopavo*). *Journ. Hered.*, 41: 205-207, 2 tables.

AUSTIN, OLIVER L. 1949. Notes on the birds of the Izu Islands. *Tori*, 12 (59): 262-267.—Report on 200 specimens of 60 forms; only additions or changes in status are presented in detail.

BÄHRMANN, UDO. 1950. Das Totalgewicht des Hühnerhabichts, *Accipiter gentilis gallinarum* (Br.), und seine Bedeutung als Hilfsmittel zur Unterscheidung der Habichtsrassen. *Vogelwelt*, 71 (5): 177-183, 2 tables.—Seasonal variation in weights of *A. g. gallinarum* and *A. g. tischleri*—males, females, and juveniles.

BAILEY, ROBERT E. 1950. Inhibition with prolactin of light-induced gonad increase in White-crowned Sparrows. *Condor*, 52 (6): 247-251, 2 figs.—Prolactin did inhibit this type of recrudescence of the gonads; singing did not occur in the experimental which may indicate inhibition of production of sex hormones.

BAKKER, D. 1950. Een nieuw broedgeval van de grauwe gans, *Anser a. anser* (L.) in Nederland. *Limosa*, 23 (3-4): 357-364, 2 figs., 2 tables.—English summary. First recorded nesting of Gray Goose in the Netherlands since 1909.

BAKKER, D., AND A. STAM. 1950. Noordoostpolderbewoners, 8e bericht; broedseizoen 1949. *Limosa*, 23 (3-4): 292-315, 2 figs., 4 maps.—English summary. Data on breeding birds that have moved into a reclaimed part of the Zuidersee, which was again put under cultivation in 1949.

BALTHASAR, VLADIMÍR. 1950. Ptactvo gottwaldovského (zlínského) regionu. *Sylvia*, 11-12 (1): 1-36, 1 pl.—French summary. Species accounts of birds of

- region of Zlin, southeast Moravia; 227 forms of which 129 breed and 83 are migrants or winter visitants.
- BANKS, E. 1950. Breeding seasons of birds in Sarawak and North Borneo. *Ibis*, 92 (4): 642.
- BEHLE, WILLIAM H. 1950. A new race of Mountain Chickadee from the Utah-Idaho area. *Condor*, 52 (6): 273-274.—*Parus gambeli wasatchensis* (Silver Lake P. O. (Brighton), 9,000 feet, head of Big Cottonwood Canyon, Wasatch Mts., Salt Lake Co., Utah).
- BLAKE, EMMET R. 1950. Report on a collection of birds from Guerrero, Mexico. *Fieldiana: Zool.*, 31 (39): 375-393.—Twelve additional species in 342 specimens of 109 forms; species accounts contain gross data on condition of gonads.
- BLAKE, EMMET R. 1950. Report on a collection of birds from Oaxaca, Mexico. *Fieldiana: Zool.*, 31 (40): 395-419.—Adds 126 forms to the known avifauna, mostly of tropical origin.
- BLAKE, EMMET R. 1950. Birds of the Acary Mountains, Southern British Guiana. *Fieldiana: Zool.*, 32 (7): 419-474, map.—Physical characteristics and faunal affinities of the region are discussed; accounts of 156 forms (500 specimens) of which 17 are additions to fauna of British Guiana.
- BOND, JAMES. 1950. Some remarks on West Indian Icteridae. *Wilson Bull.*, 62 (4): 216-217.—Questions several points made by Beecher (*Wilson Bull.*, 62: 51-86, 1950) as to invasion routes and "production" of certain adaptations.
- BRIAN, MICHAEL V., AND ANNE D. BRIAN. 1950. Bird predation of defoliating caterpillars. *Scot. Nat.*, 62 (2): 88-92, 2 tables.—Experimental and statistical study to show that birds may exert a depressing effect on populations of certain caterpillars.
- BRUNS, HERBERT. 1950. Pflanzenassoziation, Biotop und Vogelwelt. *Orn. Mitt.*, 2 (7): 157-162.
- BUSSMANN, JOSEF. 1950. Zur Brutbiologie des Wiedehopfes (*Upupa epops*). *Orn. Beob.*, 47 (4): 141-151, 4 figs.—Pair-formation, incubation period, brooding, feeding of young, relative rate of growth of young.
- CLANCEY, P. A. 1950. A new race of *Turdus viscivorus* Linnaeus from the western Palaearctic. *Limosa*, 23 (3-4): 337-338.—*Turdus viscivorus precentor* (Darnley, E. Renfrewshire, SW. Scotland).
- CLARK, CHARLES T., AND MARGARET M. NICE. 1950. William Dreuth's study of bird migration in Lincoln Park, Chicago. *Chicago Acad. Sci. Spec. Publ. No. 8*: 1-43, 6 tables, 1 pl.—A tabulation of 16 years of observation in the field. The 256 species (260 subspecies) are listed as to: earliest and latest dates seen; average date of arrival; frequency of observation; and changes in status. Twenty-nine species are included as breeding in the Park.
- CONDON, H. T. 1950. The Royal Penguin in Australian waters. *Emu*, 50 (1): 59-61.—Records specimen of *Eudyptes schlegeli* from South Australia and gives key to the species of *Eudyptes*.
- CURRY-LINDAHL, KAI. 1950. Berguven, *Bubo bubo* (L.), förekomst i Sverige jämte något om dess biologi. *Vår Fågelvärld*, 9 (3): 113-165, 5 photos, 1 table, 1 map.—English summary. Occurrence of Eagle Owl in Sweden and details of its biology. All known records summarized to show great decrease in numbers; reasons for decline; breeding behavior; food habits.
- DANFORTH, C. H. 1950. Evolution and plumage traits in Pheasant hybrids, *Phasianus x Chrysolophus*. *Evol.*, 4 (4): 301-315.—Most of the "taxonomic characters" are shown to be the result of relatively large gene complexes. It is



suggested that recessive mutations perhaps play a greater rôle in evolutionary progress than has been suspected. Many of the plumage traits, which in those forms seem to be the result of action of groups of genes, behave in first generation hybrids as though they were simple, recessive units.

- DE HAAN, G. A. L. 1950. Notes on the invisible [sic] flightless rail of Halmahera. *Amsterdam Nat.*, 1: 57-60.—Habits of the little known *Habroptila wallacii*, with colored plate.
- DEIGNAN, H. G. 1950. A tentative revision of the Australian races of the Grey-crowned Babbler, *Pomatostomus temporalis* (Vigors and Horsfield), with descriptions of two new subspecies. *Emu*, 50 (1): 17-21.—*P. t. mountfordae* (Groote Eylandt, Gulf of Carpentaria), *P. t. browni* (between Yirrkala and Melville Bay, Cape Arnhem Peninsula).
- DEIGNAN, H. G. 1950. Two new races of the Spotted Nightjar. *Emu*, 50 (1): 21-23.—*Eurostopodus guttatus gilberti* (Ambukwamba, Groote Eylandt, Gulf of Carpentaria), *E. g. insulanus* (Tepa, Babar Island, Banda Sea).
- DELACOUR, JEAN. 1950. Variability in *Chloephaga picta*. *Amer. Mus. Nov.*, No. 1478: 1-4.—Recognizes *C. p. picta* from southern tip of S. America and *C. p. leucoptera* from the Falkland Islands.
- DESCHAUENSEE, RODOLPHE MEYER. 1950. Colombian Zoological Survey, Part VII.—A collection of birds from Bolívar, Colombia. *Proc. Acad. Nat. Sci. Philadelphia*, 102: 111-139.—*Ramphocelus dimidiatus molochinus* (San Angustín, 5100 ft., Huila, Colombia), *Spermophila aurita chocoana* (Nuquí, 300 ft., Chocó, Colombia), new subspecies.
- DUFFEY, ERIC. 1950. Non-breeding in the Fulmar *Fulmarus glacialis*. *Scot. Nat.*, 62 (2): 111-121.—Non-breeding Fulmars are usually present in breeding colonies. It is suggested that the Fulmar breeds in its third year and then every two years, or that it breeds in its third year and then every three years.
- DUFFEY, ERIC, AND DAVID E. SERGEANT. 1950. Field notes on the birds of Bear Island. *Ibis*, 92 (4): 554-563.—List of 28 species with notes on status, reproduction, and food habits.
- EISENMANN, EUGENE. 1950. Behavior and habitat of *Thryophilus leucotis* in Central Panamá. *Wilson Bull.*, 62 (4): 216.
- EVANS, FRANCIS C. 1950. Relative abundance of species and the pyramid of numbers. *Ecology*, 31: 631-632.—Three graphic presentations are given, analyzing relative abundance of 79 species of breeding-birds on a 17000-acre tract in New York State.
- FLEAY, DAVID. 1950. Random notes on the White Goshawk. *Emu*, 50 (1): 1-4, 2 pls.
- FLEMING, C. A. 1950. New Zealand Flycatchers of the Genus *Petroica* Swainson. *Trans. Roy. Soc. New Zealand*, 78: 14-47, 127-160.—In this systematic study of the New Zealand flycatchers the author includes in one genus the species hitherto included in the genera *Petroica* and *Miro*, this latter genus being reduced to the rank of subgenus. The classification adopted is as follows: *Petroica* (*Petroica*) *macrocephala macrocephala*, *P. (P.) m. toitoi*, *P. (P.) m. chathamensis* n. name, *P. (P.) m. marrineri*, *P. (P.) m. dannefaerdi*, *P. (Miro) australis australis*, *P. (M.) a. rakiura* new subspecies, *P. (M.) a. longipes*, *P. (M.) traversi*. The main changes involved are the merging of *macrocephala* and *toitoi* in one species, of *australis* and *longipes* in another species, and the transfer of *dannefaerdi* from *Miro* to *Petroica*. Each subspecies is treated fully under the headings—characters, moult and plumages, habitat, general habits, nest and eggs, affinities, distribution.—W. R. B. Oliver.



- FORD, RICHARD L. E. 1950. Eggs and Nests of British Birds. (Adam and Charles Black, London), pp. vi + 7-96, 24 pls. (8 col.). Price, \$1.25.—Another in "Black's Young Naturalist's Series"; excellent photographs and colored plates of eggs.
- GÉROUDET, PAUL. 1950. La Fauvette orphée aux environs de Genève *Sylvia hortensis* Gm. Nos Oiseaux, 20 (211/12): 221-232, 2 figs., 1 photo.—Distribution, ecological niche, migration dates, behavior, song, nests, and eggs.
- GIBB, JOHN. 1950. The breeding biology of the Great and Blue Titmice. Ibis, 92 (4): 507-539.—In the first three months of 1947, 200 nesting boxes were placed in a mixed deciduous wood at a density of about two boxes per acre. The combined population of the two species increased from 43 pairs in 1947 to 135 pairs in 1949 with practically all pairs of both species using the boxes. Breeding dates varied from two to three weeks in different years; it is believed that the exact season is timed to the period of abundance of the particular species of larvae on which the young are fed. The average number of eggs per clutch for *Parus major* varied from 10.0 in 1949 to 12.3 in 1948; for *P. caeruleus* 10.4 in 1949 to 13.4 in 1947. The author distinguishes between "repeat clutches" (following desertion of first clutches) and "genuine second clutches" (following the successful rearing of a first brood). There is much valuable information on the egg weights of both species, variation of egg weight with clutch size, temperatures during incubation, nestling weights of first and second broods, nestling periods, etc. Exclusive of losses due to human agency, the breeding success of both species of tits was about 90 per cent.—J. Peters.
- GIBSON, J. A. 1950. Methods of determining breeding-cliff populations of Guillemots and Razorbills. Brit. Birds, 43 (10): 329-331.
- GRABER, RICHARD AND JEAN. 1950. New birds for the state of Kansas. Wilson Bull., 62 (4): 206-209.—Twelve forms.
- GROSS, ALFRED O. 1950. Nesting of the Streaked Flycatcher [*Myiodynastes luteiventris*] in Panama. Wilson Bull., 62 (4): 183-193, 3 photos, 1 table.—Also some data on call notes and food habits.
- GULLION, GORDON W. 1950. Voice differences between sexes in the American Coot [*Fulica americana*]. Condor, 52 (6): 272-273, 1 fig.—Female calls are nasal-like and lower than those of male; male lacks nasal quality; correlated with differences in structure of syrinx, which are figured.
- HACHISUKA, MASAUJI. 1949. A biography of Marquis Kuroda. Tori, 12 (59): 212-215.—In Japanese.
- HACHISUKA, MASAUJI. 1949. President Kuroda's Zoological Bibliography. Tori, 12 (59): 218-261.—In Japanese.
- HARTLEY, P. H. T. 1950. An experimental analysis of interspecific recognition. Symposia Soc. Exp. Biol., No. 4, Animal Behaviour, pp. 313-336, 4 figs., 1 pl., 2 tables.—Using the mobbing reaction as the criterion of recognition, it was found that many passerine species recognized owls by the same combination of visual characters. The process is thought to be innate.
- HINDWOOD, K. A. 1950. The Little Grass-bird in Queensland. Emu, 50 (1): 36-40.—The five published records for the occurrence of *Megalururus gramineus* are based on sight or voice and are not considered acceptable from a scientific standpoint.
- HINDWOOD, K. A. 1950. The late Neville W. Cayley: an appreciation. Emu, 50 (1): 52-56.
- HINDWOOD, K. A., AND J. M. CUNNINGHAM. 1950. Notes on the birds of Lord Howe Island. Emu, 50 (1): 23-35, 2 pls.

- HOGG, PETER. 1950. Some breeding records from the Anglo-Egyptian Sudan. *Ibis*, 92 (4): 574-578.
- KELSO, LEON. 1950. Testing the film on the feather. *Biol. Leaflet No. 53*: 1-2.—Surface film on feather conducts current.
- KLIMMEK, FRITZ. 1950. Brutbiologische Beobachtungen beim Weissternigen Blaukehlchen [*Luscinia svecica cyaneola*]. *Vogelwelt*, 71 (5): 145-148.—Time of nesting and behavior.
- KOSKIMIES, JUKKA. 1950. Tuloksia Riistaelainten Merkitsemisestä Suomessa vv. 1947-49. *Suomen Riista* (Helsinki), 5: 134-143.—English summary. Records of 30 recoveries from 1500 wing-marked birds and ear-marked mammals.
- KRAMER, GUSTAV. 1950. Der Nestbau beim Neuntöter (*Lanius collurio* L.). *Orn. Ber.*, 3 (1): 1-14, 2 figs.—Nest construction.
- KRAMER, GUSTAV. 1950. Über die Mauser, insbesondere die sommerliche Kleingefiedermauser beim Neuntöter (*Lanius collurio* L.). *Orn. Ber.*, 3 (1): 15-22, 1 table.
- KRAMER, VOLKHARD. 1950. Ernährungsbiologische Beobachtungen an den Horsten des Sperbers (*Accipiter n. nissus* L.) in der südlichen Oberlausitz von 1944-1948. *Vogelwelt*, 71 (5): 183-189.—Foods taken by more than 84 breeding pairs are given in tabular form by years.
- LACK, DAVID. 1950. Family-size in Titmice of the genus *Parus*. *Evol.*, 4 (4): 279-290, 11 tables.—Hatching success is similar for clutches of all sizes but survival over long periods may be slightly lower in large broods. It may be that small clutches are laid when conditions for raising young are less favorable. Clutch-size decreases markedly as the laying season advances and as food supply declines, but seasonal, regional, and individual differences in clutch-size are so great that one can hardly generalize on the data presented.—H. I. F.
- LANZ, HANS. 1950. Vom Dreizehenspecht (*Picoides tridactylus alpinus* Brehm) und seinem Brutleben. *Orn. Beob.*, 47 (4): 137-141.
- LASKEY, AMELIA R. 1950. Cowbird behavior. *Wilson Bull.*, 62 (4): 157-174, 1 table, 1 photo.—Songs, call notes, display, social dominance, pair formation, copulation, territory, and egg-laying were observed in 29 color-banded individuals.
- LEA, ROBERT B., AND ERNEST P. EDWARDS. 1950. Notes on birds of the Lake Patzcuaro Region, Michoacan, Mexico. *Condor*, 52 (6): 260-271, 1 fig.—Brief notes in species accounts.
- LEOPOLD, A. STARKER. 1950. Vegetation zones of Mexico. *Ecology*, 31: 507-518.—Types of vegetation recognized and mapped: boreal forest, pine-oak forest, chaparral, mesquite-grassland, desert, cloud forest, tropical rain forest, tropical evergreen forest, tropical savannah, tropical deciduous forest, thorn forest, arid tropical scrub.
- LINDROTH, HELMER, AND LARS LINDGREN. 1950. Metson Hakomisen Metsänhoitolisesta Merkitystiestä. *Suomen Riista* (Helsinki), 5: 60-81.—English summary. A study of the effect produced on trees by the habit of the Capercaillie, *Tetrao urogallus* L., of feeding on pine-needles.
- LINSDALE, JEAN M. 1950. Observations on the Lawrence Goldfinch. *Condor*, 52 (6): 255-259, 2 figs.—Natural history notes including: food, habitat, flocking, courtship, nesting, incubation, and attentive periods.
- LIPPENS, L. 1950. Migration d'Etourneaux [*Sturnus vulgaris*] à l'Embouchure de l'Escaut et au littoral Belge. *Gerfaut*, 40 (3): 73-102, 7 figs.—Routes of migration; numbers; time of migration; and behavior.

- LONG, DOROTHY A. C., *et al.* 1950. [Concealment of food by Coal-Tit and Marsh-Tit]. *Brit. Birds*, 43 (10): 335-337.
- LOWTHER, E. H. N. 1950. *A Bird Photographer in India*. (Oxford Univ. Press, London), pp. xii + 150, 78 pls. Price, \$5.50.—Excellent photographs of many little-known birds; natural history notes in narrative.
- MACKWORTH-PRAED, C. W., AND C. H. B. GRANT. 1950. On the relationship of *Pternistis afer* (Müller), *Pternistis cranchii* (Leach), and *Pternistis humboldtii* (Peters). *Ibis*, 92 (4): 596-601.—*Pt. afer* is maintained as a distinct species; *Pt. cranchii* and *Pt. humboldtii* are considered conspecific. The authors recognize 16 races of *cranchii* which are listed together with their synonyms, characters, and geographic distribution.
- MACLAREN, P. I. R. 1950. Bird-ant nesting associations. *Ibis*, 92 (4): 564-566.—Near Lagos, Nigeria, *Spermestes cucullatus* prefers to nest in trees in which a species of a large red ant is also nesting.
- MACQUEEN, PEGGY MUIRHEAD. 1950. Territory and song in the Least Flycatcher [*Empidonax minimus*]. *Wilson Bull.*, 62 (4): 194-205, 1 fig., 2 tables.—At Douglas Lake, Michigan, 44 nests were studied in 1942, 1944, and 1946. Population of broken aspen woods was 200 to 271 pairs per 100 acres; in uniform, unbroken aspen woods it was 70 pairs per 100 acres. Territories were of two kinds—one in which the pair mated, nested, and fed throughout the reproductive cycle, and one in which pair mated and nested but fed in undefended, communal areas. Thirty-three territories averaged 0.18 acres in extent and were defended primarily by males.
- MARIEN, DANIEL. 1951. Notes on the bird family Prunellidae in southern Eurasia. *Amer. Mus. Nov.*, No. 1482, 28 pp.—A careful study of the genus *Prunella* based chiefly upon 350 specimens in the Walter Koelz Collection. Subspeciation, speciation, and ecology are considered. Although several of the 12 species of the genus may exist in the same general region, they are, with one doubtful exception, rather clearly separated ecologically, and hence probably do not compete severely with each other.—D. A.
- MARSHALL, A. J. 1950. The function of vocal mimicry in birds. *Emu*, 50 (1): 5-16, 1 pl.—In Australia at least, the superior mimics are found among those species in whose habitat visibility is restricted by dense vegetation. It is suggested that lack of visibility renders it biologically advantageous for birds to rely more on sound in announcing territory.
- MASTROVIĆ, ANTUN. 1947. *Charadrius alexandrinus alexandrinus* u oblasti jugoslavenske faune. *Hrvatsko Prirodoslovno Društvo* (Soc. Sci. Nat. Croatica), Glasnik, ser. II/B, T. 1: 99-108, pl. 5. (Resumé in Yugoslav.)
- MAYR, ERNST, AND E. THOMAS GILLIARD. 1950. A new Bower bird (*Archboldia*) from Mount Hagen, New Guinea. *Amer. Mus. Nov.* No. 1473: 1-3.—*Archboldia papuensis sanfordi*, new subspecies from sw. slope of Mt. Hagen, 4 mi. W. Tomba, Central Highlands, New Guinea.
- MAYR, ERNST, AND ERWIN STRESEMANN. 1950. Polymorphism in the Chat genus *Oenanthe* (Aves). *Evol.*, 4 (4): 291-300, 2 figs., 2 tables.—Six of 18 species show polymorphism in which a certain character is either present or absent (not partial or continuous as it would be if controlled by a series of genes). Many so-called "neutral characters" may actually have selective value.
- McELROY, THOMAS P., JR. 1950. *Handbook of Attracting Birds*. (Alfred A. Knopf, New York), pp. xiv + 163, 51 line cuts. Price, \$2.75.—Ways and means

- of attracting birds by artificial means (feeding, boxes, etc.) and by improvement of natural environment (planting for food and cover, water).
- MEINERTZHAGEN, R. 1950. The Namib of South West Africa. *Ibis*, **92** (4): 567-573.—Description of the Namib, a strip of coastal desert between the Kunene River and Port Nolloth, and a generalized account of its bird life.
- MILLER, ALDEN H., AND ROBERT W. STORER. 1950. A new race of *Parus sclateri* from the Sierra Madre del Sur of Mexico. *Journ. Wash. Acad. Sci.*, **40** (9): 301-302.—*P. s. rayi* (Omiteme, Guerrero, Mexico).
- MILON, LT. COL. PH. 1950. Quelques observations sur la nidification des sternes dans les eaux de Madagascar. *Ibis*, **92** (4): 545-553.—*Hydroprogne caspia* breeds in Madagascar on small islands near Diégo-Suarez Bay, near Tuléar, and near Tamatave; *Sterna bergii* and *Sterna bengalensis* breed on Nosy-Tsara near Diégo-Suarez Bay; *Sterna dougallii*, 4000 pairs breed on Nosy-Manitra off the southwest coast, also believed to breed in the Tamatave region, east coast. *Sterna fuscata nubilosa* and *S. anaetheta* breed in small numbers on Nosy-Manitra and Nosy-Mborono. *Anous t. tenuirostris* in small numbers on Nosy-Manitra.
- MOLTONI, EDGARDO. 1950. Dati positive sull'alimentazione dei Rondoni (*Micropus*) in Italia. *Riv. Ital. Orn.*, **20** (4): 140-144.—Foods of *Micropus apus* and *M. melba* in Italy.
- MOORE, ROBERT T. 1950. A new race of *Melanerpes chrysogenys* from Central México. *Proc. Biol. Soc. Wash.*, **63**: 109-110.—*M. c. morelensis* (Cuernavaca, Morelos, México, altitude 4700 feet).
- MOREAU, R. E. 1950. A "stepped cline" in *Bessonornis*. *Ibis*, **92** (4): 642-643.
- NOVAES, FERNANDO C. 1950. Sobre las Aves de Sernambetiba, Distrito Federal, Brasil. *Rev. Brasil. Biol.*, **10** (2): 199-208, 1 table, 4 photos.—Breeding populations of 26 species in August, September, and October, and their relationship with vegetation types.
- ODUM, EUGENE P. 1950. Bird populations of the Highlands (North Carolina) Plateau in relation to plant succession and avian invasion. *Ecology*, **31**: 587-605.—Breeding populations varied between 396 and 160 pairs per 100 acres in shrubland, intermediate forest, and climax forest in the hemlock and the oak-chestnut seres. Species composition varied markedly between shrubland and forest but was essentially the same in mixed conifer and hardwood in North Carolina, West Virginia, and New York.
- OHTA, HARUO. 1949. A life history of *Alseonax l. latirostris*. *Tori*, **12** (59): 269-271.—Nesting habits noted briefly; suggestion that two broods may be raised annually. In Japanese.
- PAAVOLAINEEN, EERO-PEKKA. 1950. Piirteita provoon Lantisen Saaris-toalueen Linnustosta. *Suomen Riista* (Helsinki), **5**: 28-59.—English summary. Description and measurement of bird populations in the western archipelago of Porvoo.
- PALMGREN, PONTUS. 1949. Some remarks on the short-term fluctuations in the numbers of northern birds and mammals. *Oikos*, **1**: 114-121.—The average interval between peaks of population in seven species of European birds and in eight species of mammals varies from 3.13 to 4.00 years. These fluctuations seem explainable "as a compound result of random variation of some master factors, apparently climatic, and the influence of the population density of the preceding year."
- PAULUSSEN, W. 1950. Nidologische Aantekeningen over de Spotvogel [*Hippolais icterina*]. *Gerfaut*, **40** (3): 103-106.—121 nests studied; normal set is 5 eggs; incubation is 13 days; territories established in late April or early May; nesting starts early in June.

- PENNIE, IAN D. 1950. The history and distribution of the Capercaillie [*Tetrao urogallus*] in Scotland (to be cont.). Scot. Nat., 62 (2): 65-87.—Introduction of, habitat, and present distribution.
- PHELPS, WILLIAM H., AND WILLIAM H. PHELPS, JR. 1950. Three new subspecies of birds from Venezuela. Proc. Biol. Soc. Wash., 63: 43-50, 1 pl.—*Lepidocolaptes souleyetii uaireni* (Hato Santo Teresa, Bolívar); *Diglossa duidae parui* and *Atlapetes personatus parui* (Cerro Paru, Terr. Amazonas).
- PHILLIPS, ALLAN R. 1950. The pale races of the Steller Jay. Condor, 52 (6): 252-254.—Recognizes: *Cyanocitta stelleri macrolopha* Baird; *C. s. diademata* (Bonaparte); and *C. s. browni*, new subspecies from Carter Canyon, near Summerhaven, Santa Catalina Mts., Arizona.
- PRESTWICH, ARTHUR A. 1950. Records of Birds of Prey Bred in Captivity. (A. A. Prestwich, Southgate, London), pp. 1-24.
- PYNNÖNEN, ALPI. 1950. Pynn elintavoista. Suomen Riista (Helsinki), 5: 7-27.—English summary. Mating and nesting behavior of the Hazel Grouse, *Tetrastes b. bonasia*.
- RAITASUO, KALEVI. 1950. Peto-, Varis- ja Lökkilintu-Jemme Tenteminen. Kenttäopas metsästäjille ja riistanhoitajille. Hur Man Känner Igen Våra Rov-, Kråk- och Måsfåglar. Suomen Riista (Helsinki), 5: 92-133.—English summary. A field guide, with many original drawings, to birds of prey, crows, gulls, and terns.
- RICHDALE, L. E. 1950. The Pre-egg Stage in the Albatross Family. (Biol. Monog. No. 3). (Otago Daily Times, Dunedin, N. Z.), pp. 1-92, 7 tables, 13 figs. Price, 12/6.—This work is a detailed account of the habits of the Royal Albatross, *Diomedea epomophora sanfordi*, at Taiaroa Head, Otago, and a shorter account of other species of the family Diomedidae, especially *D. exulans*, *D. immutabilis*, and *D. bulleri*. Under each of these two main headings the information is given under three subheadings: type of behavior, behavior of breeding birds, unemployed birds. The author defines a number of types of behavior such as, billing, yapping, sky call, gawky look, parties, visiting, clapping, and so on. A general discussion concludes the book. W. R. B. Oliver.
- RINGLEBEN, HERBERT. 1950. Zur Ausbreitung und Verbreitung des Weisstorches, *Ciconia c. ciconia* (L.), in Nordost-Europa. Orn. Ber., 3 (1): 27-53, 1 fig.
- SCHWARTZ, CHARLES W., AND ELIZABETH REEDER SCHWARTZ. 1950. Breeding habits of the Barred Dove in Hawaii with notes on weights and sex ratios. Condor, 52 (6): 241-246, 2 figs., 3 photos.—Breed throughout the year but two periods of increased activity occur; development up to 10 days is described; weight of adult males, 59.7 grams; weight of adult females, 55.2 grams; sex ratio in 207 adults was 115 males to 100 females.
- SERLE, WILLIAM. 1950. A contribution to the ornithology of the British Cameroons. Ibis, 92 (4): 602-638.—This second and concluding installment, while devoted largely to taxonomy and distribution, contains numerous field notes and descriptions of nests and eggs.
- SICK, HELMUT. 1950. Eine neue Form von *Dendrocicla fuliginosa* vom Alto Xingu, Zentralbrasilien (*D. f. trumaii* subsp. nova). Orn. Ber., 3 (1): 23-26.
- SICK, HELMUT. 1950. Contribuição ao Conhecimento da Ecologia de "Chordeiles rupestris" (Spix) (Caprimulgidae, Aves). Rev. Brasil. Biol., 10 (3): 295-306, 3 figs., 2 photos.—English summary. Refers to biology of this Nighthawk in the Mato Grosso. A sand-colored bird, this species lives and nests on low, sandy, open areas. Terrestrial locomotion is gull-like, and flight and voice are tern-like. It is quite active diurnally.



- SIMMONS, K. E. L. 1950. A Buff-backed Heron incapacitated by Mallophaga. *Ibis*, 92 (4): 648.
- SIMMONS, K. E. L. 1950. Display of the Egyptian Hoopoe *Upupa epops major*. *Ibis*, 92 (4): 648.
- SNOW, D. W. 1950. The birds of São Tomé and Príncipe in the Gulf of Guinea. *Ibis*, 92 (4): 579-595.—The islands lying about 150 miles off the coast of Africa are of volcanic origin. Little of the original forest remains on either except on the less accessible slopes. But 13 species of resident land birds are common to the two islands; the commonest species are mostly the endemic ones, and it is the non-endemic ones that are now in danger of extinction. The annotated list of species contains much useful information on status, habits, breeding, voice, and food.
- SORENSEN, J. H. 1950. The Royal Albatross. Scientific Results of the New Zealand Sub-Antarctic Expedition 1941-45. Cape Expedition Series Bull. No. 2: 1-39 (Wellington, N. Z.).—The author spent several years at the Auckland and Campbell Islands as a member of one of the watching parties stationed there during the war. Detailed investigation of the life history of the Royal Albatross, *Diomedea e. epomophora*, was made on Campbell Island. The scope of the research is shown by the following section headings: habitat, mortality, unusual behavior, walking and flight, sexual dimorphism, courtship and nesting, eggs and incubation, hatching of the chicks, food and feeding, moult and parasites, weekly description of chicks, history of the royal albatross colony. The author records the fact, not known before his visit, that the sexes of the subspecies of Royal Albatross on Campbell Island differ in color and size. The male has more white on the humeral flexure than the female. The sexes of *D. e. sanfordi* are similar in color. The report is amply illustrated by tables, graphs, and photographs.—W. R. B. Oliver.
- SUTTON, GEORGE MIKSCHE. 1950. The Crimson-collared Grosbeak [*Rhodothraupis celaeno*]. *Wilson Bull.*, 62 (4): 155-156, 1 col. pl.—Natural history notes.
- SVÄRDSON, GUNNAR. 1949. Competition and habitat selection in birds. *Oikos*, 1: 157-174.—Birds select their proper habitat through a "heterogenous summation of stimuli" from the outside. These stimuli are analyzed for four species of *Anthus*. Both intraspecific and inter-specific competition is discussed and related to distribution, speciation, and fluctuations in abundance.
- TEBBUTT, C. F. 1950. Birds becoming "caught" in flocks of other species. *Brit. Birds*, 43 (10): 332-333.—Wood-pigeon unable to escape from flock of Mallards, with which it had flushed, until ducks settled on water.
- TINBERGEN, L. 1950. Der geheime Finkenzug. *Orn. Beob.*, 47 (5/6): 164-170.—Effects of meteorological conditions on the fall flights of *Fringilla coelebs*.
- TODD, W. E. CLYDE. 1950. A new race of Hudsonian Chickadee. *Ann. Carnegie Mus.*, 31: 333-334.—*Parus hudsonicus labradorius* (Rigolet, Labrador).
- VAN BENEDEEN, A. 1950. Moeurs hivernales du Pipit Aquatique *Anthus sp. spinoletta* (L.). *Gerfaut*, 40 (3): 107-119.—Song, behavior, pairing.
- VAN IJZENDOORN, A. L. J. 1950. Broedvogels van de Wieringermeer in 1948 en 1949. *Limosa*, 23 (3-4): 338-357, 4 figs.—English summary.—Breeding birds of a part, reclaimed in 1930, of the Zuidersee; analysis of changes in populations.
- VAURIE, CHARLES. 1950. Notes on some Asiatic Nuthatches and Creepers. *Amer. Mus. Nov.* No. 1472: 1-39, 4 figs., 6 tables.—*Sitta europaea hoelsi* (Patkai Hills, Assam-Burma border), new subspecies; primarily taxonomic.
- VAURIE, CHARLES. 1950. Variation in *Oenanthe lugubris*. *Ibis*, 92 (4): 540-544.
- VERHEYEN, R., AND GEO. LE GRELLE. 1950. Interpretation des Resultats du



- Baguage Relatifs au Pipit des Pres *Anthus pratensis* (L.). Gerfaut, 40 (3): 124-131.
- VERHEYEN, R. 1950. Etude relative a la Migration et aux Quartiers d'Hiver du Faucon Hobereau (*Falco subbuteo*). Gerfaut, 40 (3): 142-152.
- VERHEYEN, R. 1950. Resultats du Baguage des Oiseaux en Belgique—Exercice 1949. Gerfaut, 40 (3): 152-177.—Lists of recoveries and distances traveled.
- VLEUGEL, D. A. 1950. Windrichtung und Zugstärke beim Buchfinken (*Fringilla coelebs* L.). Orn. Beob., 47 (5/6): 158-164.—Effect of wind on flights of these birds in Holland.
- VOPIO, PAAVO. 1950. Jaksoittainen Runsauden-vaihtelu Ja Paikallisten Eläinkantojen Säilyminen. Suomen Riista (Helsinki), 5: 144-164.—English summary. Study of genetic factors involved in the survival of cyclic species.
- VOOUS, K. H. 1950. Geographical variation in the Lesser Sparrow Hawks from Indonesia (*Accipiter virgatus*). Amsterdam Nat., 1: 95-107.—*Accipiter virgatus sanbemmeli*, new subspecies, from northeastern Sumatra.
- VOOUS, K. H. 1950. The post-glacial distribution of *Corvus monedula* in Europe. Limosa, 23 (3-4): 281-292, 1 fig.—The post glacial distribution of *Corvus monedula* based upon the taxonomy and the ranges of geographic races. These are compared with the distributional history of *Dendrocopos major* and *P. pyrrhula*. The present European populations appear to consist of Asiatic, southeast European, and southwest European components which were isolated from each other during the last glacial period. Additional populations from the Iberian Peninsula and North Africa probably became isolated before the last glaciation. Practically the whole of central Europe is occupied by populations which must have been derived from the southwestern European glacial refuge.—H. I. F.
- WILKINSON, D. H. 1950. Flight recorders: A technique for the study of bird navigation. Journ. Exper. Biol., 27: 192-197, 3 figs.—A device (plate and source of radiation) is described by which the actual time in flight may be determined by counting particle tracks on a negative.
- WILLIAMS, GEORGE G. 1950. The nature and causes of the 'coastal hiatus.' Wilson Bull., 62 (4): 175-182, 1 fig.—This "hiatus" appears to be a lacuna between two major migration routes. Few transient species found here in fair weather. Cold fronts and north winds often force birds into the area and out over the Gulf where they have been mistaken for trans-Gulf migrants.
- WILLIAMS, JOHN G. 1950. A new race of *Cinnyris regius* from Tanganyika. Ibis, 92 (4): 644-645.—*Cinnyris regius anderseni* (Mahari Mts., ca. 6000 feet, eastern shores of Lake Tanganyika).
- WILLIAMS, JOHN G. 1950. On the status of *Cinnyris mediocris moreau*. Ibis, 92 (4): 645-647.—Believed to be a distinct species closely allied to *C. loveridgei*.
- WILLIAMS, JOHN G. 1950. Further notes on *Cinnyris moreau*. Ibis, 92 (4): 647.
- WILSON, HUGH. 1950. The R. A. O. U. camp-out at Lake St. Clair [Tasmania], November, 1949. Emu, 50 (1): 41-51, 4 pls.—Ecological notes and species of birds observed.
- ZIMMER, JOHN T. 1950. Studies of Peruvian birds. No. 58. The genera *Chlorostilbon*, *Thalurania*, *Hylocharis*, and *Chrysura*. Amer. Mus. Nov., No. 1474: 1-31.—*Hylocharis cyanus conversa* (Camp-woods, 750 meters, Province of Sara, Bolivia), new subspecies.
- ZIMMER, JOHN T. 1950. Studies of Peruvian birds. No. 59. The genera *Polytmus*, *Leucippus*, and *Amazilia*. Amer. Mus. Nov., No. 1475: 1-27.—*Amazilia fimbriata alia* (Porto de Moz, Rio Xingú, Brazil), new subspecies.

- ZIMMER, JOHN T., AND WILLIAM H. PHELPS. 1950. Three new Venezuelan birds. Amer. Mus. Nov., No. 1455: 1-7.—*Acestrura heliodor meridae* (Páramo Conejos, State of Mérida); *Picumnus spilogaster orinocensis* (Altagracia, Orinoco R., State of Mérida) new subspecies, and *Picumnus nigropunctatus* (Araguaimujo Mission, Orinoco Delta) new species.
- ZIMMERMANN, KLAUS. 1950. Jährliche Schwankungen in der Ernährung eines Waldohreulens-Paares [*Asio otus*] zur Brutzeit. Vogelwelt, 71 (5): 152-155.—Food habits during the breeding seasons of four years.

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OBITUARIES

ROLLO HOWARD BECK, a Life Member of the American Ornithologists' Union, died at Planada, Merced Co., California, November 22, 1950, at the age of 80. He was born August 26, 1870, at Los Gatos, Santa Clara Co., California, on the west side of the Santa Clara Valley. When he was about six years old his parents moved to Berryessa on the east side of the valley where he attended grammar school, worked in the orchards, and formed a life-long friendship with Frank H. Holmes who taught him how to make bird skins and to mount birds. He joined the Cooper Ornithological Club and was elected an associate of the American Ornithologists' Union in 1894, and in 1917 became a Member of the Union.

He visited various points in California collecting birds and eggs, and while on a trip to Lake Tahoe he received an invitation to join the F. B. Webster-Harris Expedition to the Galapagos Islands to collect giant tortoises for Lord Rothschild. In 1905 he made a second expedition to the Galapagos to collect birds and tortoises for the California Academy of Sciences. The next few years were spent in collecting sea birds off the California coast near Monterey Bay and waterfowl in the San Joaquin Valley near Los Baños. In 1908 Beck made a trip to Alaska with A. C. Bent and Alexander Wetmore, and in December, 1912, he left for the coast of Peru where he rediscovered the long lost Hornby Petrel. His main work however began later in the South Pacific where, in company with his wife whom he had married in 1907, he headed the Whitney South Sea Expedition and spent several years exploring the various islands of the South Pacific and the interior of New Guinea for the American Museum of Natural History. Finally, tiring of the hardships of a wandering life of field collecting, he retired to his orchard at Planada where he spent the remainder of his life.

As a collector, Beck was noted for his beautiful symmetrical skins of sea birds and waterfowl. He developed a technique and rapidity in making skins that was unsurpassed. His field reports were illustrated with fine photographs. His publications, beginning in 1893 and extending over a period of more than 40 years, include a series of articles and short notes on California birds in 'The Auk,' 'Condor,' 'Nidologist,' and 'Osprey.' One of his most important contributions was an annotated list of 94 species of "Water Birds of the Vicinity of Point Pinos, California," published in the 'Proceedings of the California Academy of Sciences' in 1910. He also prepared a brief autobiography and a summary of his expeditions which appeared in 1936 in R. C. Murphy's "Oceanic Birds of South America."—T. S. PALMER.

GEORGE KRUCK CHERRIE, a Member of the American Ornithologists' Union, died at Newfane, Vermont, January 20, 1948, at the age of 82. He was the son of Martin and Agnes Breckenridge Cherrie and was born in Knoxville, Iowa, August 22, 1865. His education was received in the schools at Knoxville and at the State Agricultural

College at Ames, Iowa. During his long career he served as taxidermist or curator in several of the largest museums and made more than 40 field collecting trips. Described by Dr. Frank M. Chapman as a "prince of tropical American bird collectors," he knew how to make up and mount birds as well as how to find them in the jungle.

Shortly after graduation from college he spent a year at Ward's Natural History Establishment in Rochester, New York, before entering on his museum career. In 1888 he served as assistant taxidermist in the U. S. National Museum and while there received an appointment in the American Museum of Natural History. In 1889 he went to Costa Rica where he became curator of birds, mammals, and reptiles in the Museo Nacional at San José. From 1894 to 1897 he filled the position of assistant curator of ornithology in the Field Museum, now the Chicago Museum of Natural History. The next two years were spent in South America collecting specimens in the Amazon Valley for Lord Rothschild and in 1902-03 in French Guiana. Two years later he made explorations in the Orinoco Valley and on the island of Trinidad for the Brooklyn Institute of Arts and Sciences where he later served as curator of ornithology and mammalogy from 1899 to 1911. During the next 11 years he made several expeditions to various countries in northern South America, including Colombia, Ecuador, British Guiana, and his trip with Theodore Roosevelt to Brazil in 1916. In 1925-26 he was a member of the Roosevelt-Simpson Expedition of the Field Museum to Chinese Turkestan.

Cherrie was elected an Associate of the American Ornithologists' Union in 1891 but his membership lapsed from 1912 to 1916 while he was in the field. He was re-elected an Associate in 1917 and made a Member in 1918. He was an Honorary Fellow of the American Museum of Natural History and a member of the Boone and Crockett Club, Explorer's Club, Campfire Club of Chicago, and several other organizations. His principal publications in addition to descriptions of new species, included 'The Ornithology of Santo Domingo,' 1896, and 'Dark Trails, Adventures of a Naturalist,' 1930.—T. S. PALMER.

ARTHUR HERBERT EVELYN MATTINGLY, elected a Corresponding Fellow of the American Ornithologists' Union in 1921, died in Melbourne, Australia, October 1, 1950. He was born in Melbourne on July 11, 1870. His education was received at Scotch College of that city. Mattingly was a founder and past-president of the Royal Australasian Ornithologists' Union. Most of his ornithological papers appeared in 'The Emu.' They show a wide range of interest—"Bird Protection"; "Notes on the Potentialities of Guano Production in Australia"; and "The Love-Display of the Australian Bustard." One of his last was "Birds of the Hogans and other Islands of Bass Straits" (*Emu*, 38: 7-11, 1938).

Mattingly ranked high as a nature photographer, and at the Dresden International Photographic Exhibition in 1909 he was awarded first prize. He was a corresponding member of the Zoological Society of London; life member of the Royal Society for the Protection of Birds; honorary life member and past-president of the Bird Observers' Club; past-president of the Gould League of Bird Lovers; and a founder of Wyperfeld National Park, Victoria.—A. W. SCHORGER.

WILLIAM HENRY MOUSLEY, a Member of the American Ornithologists' Union, died in Montreal, Canada, September 22, 1949, in his 85th year. He was born at Taunton, Somerset, England, February 17, 1865, but spent nearly half of his life in Canada, in the Province of Quebec, where he lived for a number of years at Hatley, before moving to Montreal. At Hatley he made careful and detailed studies of the

fauna and flora and published a list of 160 or more species of the local birds. Always a careful and patient observer, he took great pains to write out full notes on his observations. His life history studies are outstanding examples of accurate and careful work.

Mousley was elected an Associate of the A. O. U. in 1915, became a Member in 1926, and was associated with the Union for nearly 34 years. His publications, most of which appeared in 'The Auk' and 'The Canadian Field-Naturalist,' included an octavo volume on the 'Birds, Orchids, Ferns and Butterflies of Hatley, Quebec, 1911-28,' a 'List of the Birds of Hatley,' 1916, and studies of the home life of the Alder Flycatcher, 1931, Northern Crested Flycatcher, 1934, an early (1815) Unpublished Drawing of the Flexibility of Woodcock's Bill, 1934, and life studies of the Short-billed Marsh Wren, 1934, Black Duck, 1936, and Spotted Sandpiper, 1937.—T. S. PALMER.

JACOB BATES ABBOTT, an Associate of the American Ornithologists' Union since 1941, died in Brattleboro, Vermont, July 14, 1950, while on a vacation. He was born in Boston on November 11, 1896. Abbott completed his junior year at Harvard in 1917. He then enlisted in the Army and served as a machine gun officer with the 28th Division in World War I.

In 1929 he moved to California and did comic strips. Five years later he devoted his efforts entirely to illustrations for wildlife and natural history publications. He did the cover portraits of birds and animals on the 'Pennsylvania Game News' from 1941 to 1949. The Library of Congress requested one of his paintings for its collection of wildlife illustrations of special merit. During his residence at Haverford, Pennsylvania, he was an active member of the Delaware Valley Ornithological Club. Through his death America lost one of its foremost wildlife artists.—A. W. SCHORGER.

HENRY WHEELER BEERS, an Associate of the American Ornithologists' Union for nearly 20 years, died at Bridgeport, Connecticut, April 2, 1914, at the age of 47. He was born at Easton, Connecticut, October 17, 1866, and was elected an Associate of the Union in 1895. He was particularly interested in the nesting of hawks and owls and published several articles on the nesting of the Red-shouldered and Cooper Hawks and the Great Horned Owl in Connecticut. His publications, in addition to notes contributed to Sage and Bishop's 'Birds of Connecticut,' included four articles in 'The Ornithologist and Oologist' and in 'The Oologist.'—T. S. PALMER.

EMILY WILLIAMS BIDDLE, an Associate of the American Ornithologists' Union for 33 years, died in Philadelphia, Pennsylvania, November 15, 1931, in her 67th year. She was born in Philadelphia, March 15, 1865, and was a resident of that city all her life. Miss Biddle was elected an associate of the A. O. U. in 1898. While she presented no papers and took no active part in the meetings, she was one of a number of prominent ladies who gave the Union their continued support and thus added to its prestige.—T. S. PALMER.

JAMES MACMASTER CODMAN, an Associate of the American Ornithologists' Union, elected in 1920, died suddenly in Brookline, Massachusetts, October 9, 1925, at the age of 63. He was born in Brookline, April 20, 1862, and was the son of James MacMaster and Henrietta Sargent Codman. His mother was a sister of Prof. Charles S. Sargent of the Arnold Arboretum. Codman graduated from Harvard University in 1894 and later from the Harvard Law School. He practiced law in Boston for a number of years. For several years he served as one of the Selectmen

of Brookline where he took an active part in civic affairs and from 1901 to 1906 served as chairman of the Board of Selectmen. He was unmarried.—T. S. PALMER.

GRANT McDONALD COOK, an Associate of the American Ornithologists' Union since 1924, died at his home in Youngstown, Ohio, on July 26, 1948, after a short illness. One of Ohio's veteran field ornithologists, he was born at Saint Thomas, Ontario, January 7, 1891, the son of John W. and Euphemia Moffett Cook. After graduating as an engineer from the University of Toronto, he went to Detroit with the Truscon Steel Company, and in 1914 transferred to Youngstown. He was associated with Truscon until his death, except for a brief period in the United States Army in 1918, and a term as city engineer of Youngstown in 1930. He leaves his wife, the former Helen Best, and two children, Margaret and John W.

Cook's interest in birds began in his youth in Canada and continued unabated throughout his life. For many years he made trips through the East and Middle West and was a regular attendant at the different stated meetings of the Union. At these meetings, his ready wit and extensive knowledge gained for his family and himself a wide circle of friends. Although he made no direct written contributions to bird literature, his wide experience made him an excellent source for others, and many of his records are scattered throughout publications on the birdlife of the Midwest. At the time of his death he was engaged in the writing of a book on the birds of the Youngstown area, in collaboration with his daughter Margaret. Cook acknowledged his debt as a student to George L. Fordyce, the great Youngstown ornithologist, by being a tireless missionary to others. He did much to interest groups and individuals, particularly young people, and many of the bird "experts" in this area trace their proficiency to his stern efforts.—VINCENT P. McLAUGHLIN.

PHILIP PATRICK MALLEY, who became an Associate of the American Ornithologists' Union in 1934, died of a heart attack on April 7, 1950, while on a train between Lancaster and Bethlehem, Pennsylvania. Born in Youngstown, Ohio, March 25, 1903, he was educated in the Youngstown Public Schools and New York University. During the last three years of his life he lived at Upper Darby, Pennsylvania, where he was a steel inspector for the engineering division of Electric Bond and Share Company. He was a contributor to the 'Oologist,' 'Wilson Bulletin,' and other journals. His wife and two daughters survive him.—A. W. SCHORGER.

SAMUEL SCOVILLE, JR., an Associate of the American Ornithologists' Union since 1916, died at Bryn Mawr, Pennsylvania, December 4, 1950. He was born in Norwich, New York, June 9, 1872, the son of Rev. Samuel Scoville and the grandson of Henry Ward Beecher. In 1893 he received an A.B. degree from Yale University and in 1895 an LL.B. from the University of the State of New York. He was admitted to the New York Bar in 1895 and the Philadelphia Bar in 1903. Much of his reputation as a writer rests on his column 'First Aid Law' begun in the 'Philadelphia Record' in 1943 and continued in 'The Bulletin' in 1947. This column over the signature, "A Philadelphia Lawyer," abounded in humor, sound advice, and an extraordinary appreciation of nature. He lunched usually at the Franklin Inn Club, of which he was honorary president, surrounded by the prominent in the literary life of Philadelphia.

His writings were voluminous and broad in scope. Contributions to 'The Auk' were notes on the Evening Grosbeak (1917 and 1922), the Pileated Woodpecker (1923), and the nesting of the Connecticut Warbler (1934). In 'Ivory-bills and Paroquets' (Yale Review, 29: 556, 1940) we have an account of a trip to South



Carolina where he was lured by the rumor of the presence of these rare species. Other publications were: 'Brave Deeds of Union Soldiers' (1915); 'Boy Scouts in the Wilderness' (1919); 'Wild Folk' (1922); 'More Wild Folk' (1924); 'Lords of the Wild' (1928); and 'Wild Honey' (1929).

Mr. Scoville was an active member of the Delaware Valley Ornithological Club; trustee of the Wagner Institute; member of the Council of the Boy Scouts of America; and vice president of the New England Society of Pennsylvania.—A. W. SCHORGER.

ELIZABETH MARTIN SHAW (Mrs. Frederick William Shaw), elected an Associate of the American Ornithologists' Union in 1947, was born in Independence, Kansas, December 12, 1887. She was married to Dr. F. W. Shaw in 1909. Returning in 1913 from the Philippines, she spent a year on the Navajo Indian Reservation in New Mexico where her interest in birds was seriously aroused. Dr. Shaw accepted a chair in the Medical College of Virginia, at Richmond, in 1924. She resided in this city until her death on July 18, 1949.

Mrs. Shaw was in great demand as a speaker on birds before the garden clubs of Richmond and vicinity, and she worked extensively with the Girl Scouts and children in the public schools. She was one of the earliest and most active members of the Virginia Society of Ornithology and conscientiously attended its meetings in spite of physical handicaps during the latter years of her life. She was also a member of the Wilson Ornithological Club. Friends will long remember her fine personality.—A. W. SCHORGER.

FANNIE ADELLE STEBBINS was born in Wilbraham, Massachusetts, September 3, 1858. She attended the Wilbraham public schools and the Westfield State Teachers College from which she was graduated in 1880. Most of her long career as a teacher was spent in the Springfield schools. In 1888 she was appointed a training teacher in science and nature study in the Springfield Normal Training School, when these subjects were relatively new as studies for children. The courses that she developed, with field trips extending to the Berkshires and throughout the Connecticut valley, were highly successful.

Miss Stebbins became an Associate of the American Ornithologists' Union in 1922. Considerable data were supplied by her to the old U. S. Biological Survey. Her leadership of the Allen Bird Club was most inspiring and helpful. Other fields than ornithology, such as botany, geology, and astronomy, commanded her attention. She was author of 'Insect Galls of Springfield, Massachusetts and Vicinity,' published in 1909. In 1938 she was made an honorary life member of the American Nature Study Society, and in the same year a fellow of the American Association for the Advancement of Science. Death occurred at Chicopee, Massachusetts, July 1, 1949.—A. W. SCHORGER.



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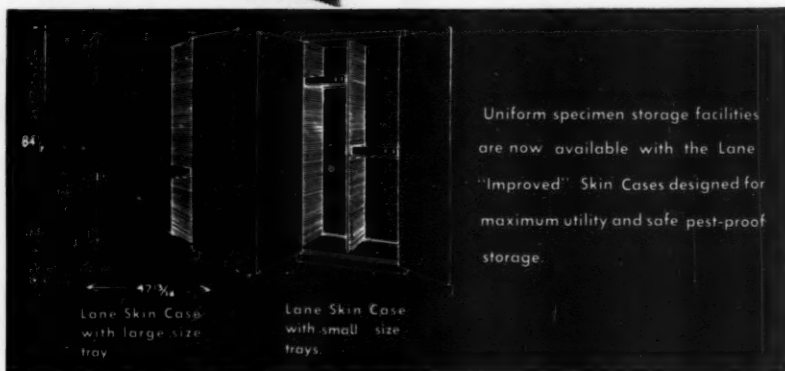
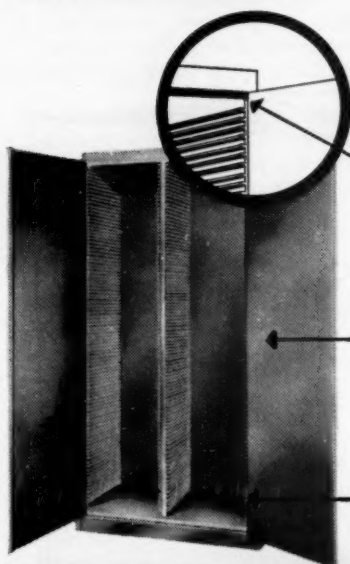
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